2002

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Secondary school teachers perceptions regarding the process of teaching sustainable agriculture in the agricultural education curriculum

by

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A dissertation submitted to the graduate faculty

in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

Major: Agricultural Education (Agricultural Extension Education)

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2002

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has met the dissertation requirements of Iowa State University

Signature was redacted for privacy.

Major Professor

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For the Major Program

DEDICATION

I dedicate this study to:

my wife Esther, for her
endurance, my children Onyema,
and Onyekwere, for their patience, and
to the memory of my parents, the Late Mr. & Mrs.
Joseph Okeafor, for seeing and believing in my dreams.

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ABSTRACT

The purpose of this study was to determine perceptions held by high school teachers of agriculture in the North Central Region of the U.S. regarding teaching sustainable agriculture in the agriculture curriculum. This region is comprised of the states of Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin.

The specific objectives for this study were to: (1) identify perceptions of teachers regarding teaching sustainable agriculture, (2) identify the extent to which selected sustainable agriculture skills and knowledge were being taught, (3) identify the extent to which inservice training is needed in selected areas of sustainable agriculture, (4) identify demographic characteristics and their relationship with selected perceptions, and (5) develop a model inservice education program for teachers of agricultural education.

The study utilized a descriptive research design with a self-administered questionnaire to collect data. The population consisted of all secondary school agriculture teachers in the twelve states of the North Central Region of the United States. The population for the study consisted of 2395 teachers as listed in the Agricultural Educator's Directory, 2000. A randomly selected sample size of 600 was used, with a usable return rate of 246.

The data were analyzed using the Statistical Package for Social Sciences (SPSS) Program. Out of the 246 respondents, 199(81%) were males and 47(19%) were females. Agriculture teachers in this study generally supported the concepts related to teaching sustainable agriculture, infusion of sustainable agriculture into the curriculum and the use of a variety of instructional methods to teach sustainable agriculture.

The respondents indicated that they needed more information and instructional materials regarding sustainable agriculture. The teachers indicated a need for inservice educational programs that would help them teach sustainable agriculture. The major topics perceived to be priority areas contributing to an understanding of sustainable agriculture included soil erosion control, soil testing, soil conservation, environmental protection and profitability.

CHAPTER I. INTRODUCTION

Agriculture is becoming more technological, more specialized, and more efficient. The primary role of agricultural education teacher is to help students learn knowledge and skills in agriculture. If the teacher's roles as producers, seekers, and disseminators of skills and knowledge are valid, the students have to be educated using different approaches to teaching. The concept implies that the teacher must have sufficient technical expertise in the field of agriculture as well as skills in imparting knowledge and facilitating learning. The real value of knowledge is when students can use it in a meaningful way (Martin and Adekunbi, 1991, pg. 13).

Teaching is a process of guided interaction between the teacher, the student, and the materials of instruction. Teaching, like medical practice, is mostly a matter of cooperation with nature, and the function of the teacher is to guide the student into the kind of experiences that will enable him to develop his own natural potentials (Carlson, 1989). We have a structure, but it is a process structure. The process structure will get at content, and the content is structured through the process. The greatest task of teachers is to retool the present generation of learners with the competencies required to function adequately in a condition of perpetual change. Learning should be a process of self-directed inquiry with the resources of the teacher, fellow students, and materials being available to the learner but not imposed on him (Carlson, 1989).

The development of effective agricultural research, extension, and education programs is vital to the achievement of sustainability (Food and Agriculture Organization of the United Nations, 1989. Pg. xvi - xvii). Education about sustainable agriculture plays a crucial role in moving us forward on our journey towards agricultural sustainability. It is critical that teachers who teach and play a major role in developing the agricultural education curriculum understand the importance of sustainable agriculture (Agbaje, 1998, pg. 4).

According to Hillison (1998), agriculture has common everyday, elementary facts with which every student should be acquainted. Such facts include the proper time for planting seeds and harvesting crops, the appearance of the various stages of development, the different kinds of soils, the use of manure, the structure and use of the common tools used on the farm and in the garden, the phenomena of the souring of milk, and the ripening of cream, the churning of butter; and a thousand and one other things common to ordinary farm life. Specialty training focused on curriculum development and a better course of study in agriculture is important if teachers are to stay up-to-date and adjust to new technologies (pg.11).

McMillan and Schumacher (1997) indicated that research in agriculture has led to increased food production, and educators must constantly understand educational processes and decisions that have both immediate and long-range effects. Teachers have education in content disciplines, instructional materials, educational processes (e.g. curricula, textbooks, school organization, structure of the teaching profession), human learning, teaching and development. They plan and develop new programs, improve educational practices, assess learning, and allocate resources to meet changing conditions and needs (pg. 1-32).

McMillan and Schumacher (1997) stated that education is a field of inquiry where the phenomena, events, people, processes, and institutions constitute the raw materials for inquiries of many kinds. Understanding the process helps learners to look at their needs and wants in new and deeper ways. Learners see their needs, problems, and circumstances in their lives, their work, and their communities. Once they have developed a deeper awareness of their problems, questions, or situations, they are ready to explore alternatives. The key

principle to this discovery is the ability to remain open. During the process of exploring alternatives. learners run into viewpoints and other ways of doing things that may counter with what they long believed (Apps. 1991).

For these reasons. discussions about teaching sustainable agriculture are apt to be lively. but given the complexity of sustainable agriculture. Norman et.al (2000) believed that it is not easy to implement. According to Norman et. al (2000) researchers and educators still do not openly concern themselves with sustainability issues. Some argue that the definition of sustainable agriculture has five parts: productivity. environmental quality. efficient use of non-renewable resources. economic viability. and quality of life (pg. 2-3).

Norman. et.al (2000) explained that a farm that emphasizes short-run profit. but sacrifices environmental quality. would not be sustainable in the long run. They stated that pursuing environmental quality without ensuring viability of short-run returns also would be unsustainable. Equally. a farm that is very productive but uses large quantities of a non-renewable resources. such as fossil fuels to achieve and maintain that productivity would not be considered sustainable in the long run. Norman et.al (2000) suggested that success in sustainable agriculture would depend on using the limited non-renewable resources (e.g. fossil energy fuels. certain chemicals) as sparingly as possible (pg. 3).

Yeutter (1990) indicated that the United States is blessed with abundant resources and excellent technology to help lead the world in agriculture. Yeutter said the richest resource of American agriculture is its people. over 20 million men and women whose talent and effort drive the abounding productivity of the food and agriculture industry. "They seek out

the best wheat varieties, select the healthiest livestock, and find the best packaging for cut flowers. They develop a system to grow food in space, and look for ways to cure or prevent diseases in plants, animals and humans. They find exciting new ways to teach young people, and the initiative, creativity, and plain hard work of these millions of people are the key to our efficiency and our ability to compete in the marketplace" (pg. iii).

Norman et.al (2000) said until World War II, increases in agricultural production primarily involved bringing more land into cultivation. They said during the last 50 years, the rate at which new land has been brought into cultivation has declined sharply. New cropland worldwide expanded at only 0.3% per year in the 1970s compared with a rate of 1% in the 1950s. Norman et al (2000) state that future increases in agricultural production will have to come primarily from increasing output per unit of land rather than increasing the area cultivated. The question is whether these gains can be maintained in a sustainable manner.

In 1992, over 1600 senior scientists, including a majority of Nobel laureates in the sciences, declared that our environment would be unable to sustain life in the manner that we know. They said a great change in our stewardship of the earth is required by creating positive alternatives of a wide variety of approaches to restore our environment. They believed that effective solutions could be possible if we could use a replicable sustainable model that makes rational use of available resources. They added that we should make maximum use of renewable energy sources, reduce dependence on non-renewable fuels, use organic agriculture without synthetic chemicals, and establish learning which would offer hands-on classes and seminars on various aspects of sustainable alternative technologies (Marga, 2000).

Markandya (1994) stated that the Food and Agriculture Organization of the United Nations (FAO) had a concern with developing technologies that would contribute to sustainable agricultural systems (pg. xi–xxiii). Markandya (1994) believed that farming on marginal lands could be carried out sustainably and productively if the right technology is used and if the right incentives are present (p. 44). The Congress of the United States. Office of Technology Assessment (1988) stated that much uncertainty surrounds the issue of technology. because a diverse array of technologies are adopted to local social. economic. and environmental conditions. The Office of Technology Assessment maintained that technological framework flexibility is needed because agricultural conditions will continue to change and at different rates. They believed that the development of technology should be flexible in order to react to anticipated and unanticipated events (pg. 12 – 14).

Jackson & Gilman (2000) argued that what we have now is not only a fossil intensive agriculture. it's an agriculture that's dependent upon chemicals. and we're narrowing the genetic base (pg. 2). In her study. Agbaje (1998) emphasized that conventional agriculture as we presently know and recognize it. involves highly specialized systems in which the emphasis is on high yields achieved with a combination of inputs including fertilizers. pesticides. and other off-farm purchases. She said that these inputs are considered high-input and resource-depleting practices although this approach has been remarkably effective in making the United States agriculture the most productive in the world (p. 15). Agbaje stated that it is these perceptions that are driving the sustainable agriculture movement today and is the compelling reason for studying alternatives to conventional agriculture systems (pg. 1-2).

Williams (1997) added that the concepts of economically sound, environmentally protective, and socially acceptable are the three widely advocated components of sustainable agriculture. He believed that the American food and fiber system could be described as a powerful industrial machine producing abundant food and robust exports. As such, Williams felt that the public expects farming to be socially and environmentally responsible, and that farmers desire to farm within more responsible boundaries (pg. 1).

Statement of the Problem

Sustainable agriculture is a relatively new field and was developed as an overarching, interconnected framework of technologies, practices and systems in response to the problems currently facing agriculture (Fretz, 1991, as stated in Agbaje (1998). As we try to learn more about sustainable agriculture, there is a parallel need to develop appropriate learning systems for our youth. Teachers of agriculture have a role in this era of sustainability.

Although many studies have been conducted in other areas of sustainable agriculture, there is lack of adequate information specifically on the secondary school teacher perceptions regarding teaching sustainable agriculture, the extent to which they teach the selected skills and knowledge, and the extent to which there is need for inservice training in this area of the curriculum. The content and quality of the education that students receive on sustainable agriculture depends very much on the perceptions and knowledge of the teachers who hold the responsibility of guiding, teaching, and facilitating the students' learning process. This, in turn, may have an impact on the students' career decisions and practices in college and in later life (Agbaje, 1998).

Because sustainability is a complex issue. it is critical to find out from agriculture teachers (1) what they believe about teaching sustainable agriculture: (2) what they are teaching about sustainable agriculture practices; and (3) the type of inservice training they require for inclusion of sustainable agriculture in the curriculum.

Purpose of the Study

The main purpose of this study was to determine the perceptions of high school teachers of agriculture in the North Central Region of the United States. regarding teaching sustainable agriculture. The study focused on teachers of agriculture in secondary schools located in the North-Central Region of the U.S. This region is comprised of the states of Illinois. Indiana. Iowa. Kansas. Michigan. Minnesota. Missouri. Nebraska. North Dakota. Ohio. South Dakota. and Wisconsin. The focus of this study was on the "teaching" of sustainable agriculture. The process of delivery and what teachers perceived to be important aspects of teaching provided the essence of the study. Sustainable agriculture related to crop production and soil management provided the context for the study of teaching in this situation.

Objectives of the study

The specific objectives for this study were as follows:

1. Identify perceptions of teachers regarding basic concepts of teaching selected sustainable agriculture topics.
2. Identify the extent to which selected sustainable agriculture skills and knowledge were being taught.
3. Identify the extent to which inservice training is needed in selected areas of sustainable agriculture.

4. Identify demographic characteristics and their relationship with selected perceptions.
5. Develop a model inservice education program for teachers of agricultural education.

Need for the Study

McMillan & Schumacher (1997) indicated that Lee S. Shulman (1987), a leading scholar in teaching and learning, suggested that there are at least four major sources for the teaching knowledge base of classroom teachers. These include (1) scholarship in content disciplines, (2) the materials and setting of the institutionalized educational process (for example, curricula, textbooks, school organizations and finance, and structure of the teaching profession), (3) research on schooling, social organizations, human learning, teaching and development, and the other social and cultural phenomena that affect what teachers can do, and (4) the wisdom of practice itself (pg. 6).

In the olden days, increases in agricultural production throughout the world involved bringing more land into cultivation (Norman, et. al 2000). According to Hytrek et al., (2000), over the past two decades, a need has arisen to find productive, cost-efficient, less resource intensive agricultural practices. This need led to the emergence of sustainable agriculture. Sustainable agriculture attempts to manage agricultural systems so that inputs and returns are optimized while protecting the environment (Williams, 1997). The key to this new and innovative program is researching and developing ideas followed by an effort to educate the population, so that we can find practical ways into the main stream. Main stream acceptance of sustainable ideas is difficult to integrate and has been known to face strong opposition (Hytrek et. al 2000).

In 1990, Congress passed the Food, Agriculture, Conservation and Trade Act which authorized the funding for agricultural research. This National Research Initiative stipulated that an emphasis be placed on research supporting sustainable agriculture. Since then, funds available for agricultural research has steadily increased, which helps to advance research in sustainable agriculture. The Sustainable Agricultural Research and Education Program is under the USDA and its mission is to increase knowledge about and help farmers adopt more sustainable practices that are profitable, environmentally-sound and beneficial to local communities and society in general (Rawson, 2001, pg. 1-6).

This study, through an assessment of teacher perceptions about teaching sustainable agriculture knowledge and skills, will provide direction for the future development of the curriculum. As we look for new information to update the curriculum, it is important agriculture education teachers find ways to improve delivery of these new areas of the curriculum. Apps (1991) suggested that teachers should help learners to become aware of problems and allow them to explore alternatives and discover answers. He went on to say they should help learners to be creative and build new or discover a different way of doing things, developing new information, and shaping values and beliefs. Learners feel better about their work and about themselves when they are actively involved in exploring and discovering, as they discover answers to problems working through a process of exploring, discovering and applying new findings to their knowledge (Apps, 1991).

Implications and Educational Significance

This study has implications to teacher preparation both at the pre-service and inservice levels. Whatever is found by the data has potential to impact the educational process. The educational significance of the study from these findings would hopefully provide

information useful to the improvement of teacher education and enhancement of the curriculum in agricultural education in secondary schools. The findings will assist high school agricultural education teachers in their decisions and curriculum planning about teaching sustainable agriculture.

Definition of Terms

The following terms were defined to guide the study.

Agricultural education: The study and practice of all the educational processes involved in becoming literate about and /or acquiring knowledge and skills in the food. fiber and natural resource system (Martin. 2000). The focus of the study was on high school agricultural education.

Agricultural Extension: A research-based integrated public non-formal educational system.

Curriculum: An organized set of formal educational and/or training plans designed for educational activities (Agbaje. 1998).

Curriculum change: An agenda for restructuring schools (McNeil. 1996).

Correlation: A procedure that measures the strength and direction of the linear relationship between two quantitative variables (Moore. 1995).

Crop rotation: A system of farming that helps restore soil nutrients. prevents crop losses to insects. and reduces erosion by keeping the soil covered by vegetation (Miller. 1998).

Descriptive statistics: Methods used to summarize the information in a collection of data (Agresti and Finlay. 1986).

Delivery: The grantor intending to give possession and control over something (Ashcroft and Ashcroft. 1996)

Ecosystem: Conceptual systems within which communities exchange energy, materials, and information with one another and with their physical environment (Agbaje, 1998).

Fertilizers: Organic or inorganic materials used to restore plant nutrients lost by erosion, crop harvesting, and leaching (Miller, 1998).

Green manure: Fresh or growing green vegetation plowed into the soil to increase the organic matter and humus available to the next crop (Miller, 1998).

Hybicide: Chemicals used to control unwanted plants growing where they are not desired

Indigenous knowledge: Culture and understanding that promote the exchange of information for sustainable development (New International Webster's Dictionary, 1996).

Inservice: Programs designed to increase teacher's sense of control over their professional development (Lickona & Hasch (1976).

Model: A miniature plan representing something in question (Ashcroft and Ashcroft, 1996)

Needs assessment: A systematic set of procedures for setting priorities and making decisions about program and allocation of resources (Owen and Rogers, 1999).

Observation: The set of measurements or data obtained for a single element

Perception: The professional and personal judgements or views of respondents regarding an event, issue, concept, or condition based on their knowledge and experience or that of others (Agbaje, 1998).

Pesticide: Any chemical used to eradicate, prevent, or inhibit pests

Programs: Non-homogeneous training activities of locally implemented projects where service delivery occurs (Owen and Rogers, 1999).

Productivity: The ratio of the value of outputs to the value of resource inputs.

Population: An entire group of individuals that we want information about (Moore, 1995).

Resources: Fixed important available materials for food output and development (Finlay and Price. 1994).

Renewable resources: Inexhaustible or replaceable materials for crop growth (Miller. 1998).

Sustainable agriculture: Approaches and practices of agricultural systems that are ecologically sound. environmentally humane. economically viable. and socially responsible (Williams. 1997).

Sample: A subset of a population of interest in a particular study

Technology: Improvements in agriculture to overcome the constraints imposed by few/scarce resources (Finlay and Price. 1994).

CHAPTER II. REVIEW OF LITERATURE

The decision about what should be taught in a course is a decision about curriculum purposes. Weiss (1998) said that programs have fuzzy boarders, so it is not always plain to determine precisely what the program was to achieve. McNeil (1996) suggested teachers differ in their desires to determine what should be taught. They incorporate a range of components, styles, people, and procedures (Weiss, 1998).

The purpose of this study was to determine the perceptions of high school teachers of agriculture regarding teaching sustainable agriculture. The specific objectives of the study were to (1) identify perceptions of teachers regarding basic concepts of teaching sustainable agriculture, (2) identify the extent to which selected sustainable agriculture skills and knowledge were taught, (3) identify the extent to which inservice training is needed in selected skills and knowledge, and (4) identify demographic characteristics and their relationship with selected perceptions.

The New International Webster's Dictionary (1996) said the review of the literature is a tool that looks back at the creative work of others and their expressions: it inspects the past in order to correct mistakes. This study draws its rationale from literature that focuses on (1) curriculum development, (2) the meaning of sustainable agriculture, (3) teacher inservice training, and (4) related research studies.

Theoretical Framework

Secondary school agriculture teacher perception's regarding the role of sustainable agriculture in the agricultural education curriculum represents the hallmark of this study. The study examines what teachers teach, ideas about teaching sustainable agriculture and needs related to inservice education.

The sustainable agriculture paradigm is new (Williams 1997) and anything new should be questioned (Kliebard,1976). The teacher facilitates growth of knowledge by creating an environment that allows the student to engage in those activities through which growth takes place (Perkinson 1993). Based on the notion that skills cannot be acquired in isolation from context, the reflective practice is a mode that integrates thought and actions with the goal of improving one's professional practice (Imel. 1992).

This study got support from the work of John Dewey (1859-1952) cited in Field (2002), who believed in the organic model of nature, and the interaction between human organisms and the environment. According to Field, Dewey believed in the interrelationship between organisms and environment, as a way to maintain efficient fulfillment of nature, society and the organic needs (pg. 1-12). Carlson (1989) added that Knowles (1913-1997) felt that we could encourage learning and advance the cause of individuals, institutions, industries, and society through reflection, clear defined goals and objectives, and technological direction to practice (pg. 1-8).

What Makes Teachers Good?

Cruickshank (2000) believed that teacher character traits, what the teacher knows, what the teacher teaches: how he teaches: what the teacher expects, and how he manages the classroom contribute to effective teaching (pg. 2-3). Borrine-Feyerabend (1999) explained that implementing, monitoring, evaluating and reviewing are starting points for learning (pg. 1). Goodlad (1961) illustrated three fundamental questions that come to mind when promoting learning to include: (1) whether such learning could be induced, (2) why such learning should be induced, and (3) how such learning could best be induced (pp. 8-10).

Borrine-Feyerabend added that learning could be facilitated through collection of data and adoption of an appropriate innovative management attitude. He maintained that compliance with these rules is essential to the effectiveness of teaching and learning (pg. 1-2). Gordon (1958) said educators need inservice education training for growth and development of professional skills. According to Gordon, when teachers attend inservice education, it helps them to recognize their strengths and weaknesses, and contributes to a better education for students (pg. 1).

Gordon (1958) believed that whenever there is change in any one major aspect of a school program, pressures for a corresponding change in other areas may arise. He said our public school system is the institution established by a democratic government to provide educational services for a society which, because it is democratic, is constantly changing and seeking ways for self-improvement. Gordon believed that the educational needs for any one community do not remain constant. As such, social change makes curriculum change inevitably necessary (pg. 275).

Curriculum Foundations and Inquiry

Manen (2002) believed that every curriculum perspective is grounded in personal knowledge and a wealth of experiences. He felt that in the field of curriculum, educational practices and inquiry, opposing the contradictory points of view are necessary for education to thrive (pg. 1). Manen assumed that every educator working at some level of education has a curriculum perspective that encourages him/her to identify and investigate the assumptions of the many things we take for granted in education (pg. 1). He was convinced that every curriculum perspective is grounded in personal knowledge and a wealth of experiences. Manen argued that personal experiences are not trivial or irrelevant but important in the ways

we interpret and integrate them into new ways of knowing, inquiry, valuing, and making sense of things (pg.1).

Beane (1975) said high school educators constantly argue about what factors have the greatest impact in high school programs, what curricular arrangements and subjects are in vogue, and what scheduling patterns and evaluations should be used. Beane stated that several groups such as the Kettering Commission on the Reform of Secondary Education, the National Association of Secondary School Principals, the National Panel on High Schools and Adolescent Education, and most recently, the Association for Supervision and Curriculum Development, have convened to study and form a working group to consider new directions in secondary education. He explained that these educators have pleaded the case for a balanced curriculum to meet the numerous goals of secondary education (pg. 129).

Beane argued that though groups have formed to reconsider the high school curriculum, the school curriculum continues to remain standardized much as it was in the past. Beane believed that the emergence of open education and innovations in secondary schools, might be avenues to put pressure on for developing a new kind of curriculum. He warned that as educators emerge with changes, new demands would be made upon high schools to follow (pg. 130).

Ausbrooks (2002) explained that the curriculum is composed of the messages in the school's social climate, unwritten yet understood by all. Ausbrooks saw this as the body of knowledge a student absorbs in school simply by being there day after day. He believed that this is the curriculum that creates a school's "learning environment". Ausbrooks argued that the hidden curriculum fosters intellectual curiosity, emotional growth, and provides opportunities for discovering new interests and developing new abilities (pg. 1-3).

Curriculum and Instructional Planning

Wilson (1997) said curriculum and instructional planning involves a complex process when we are creating unit plans, related lesson plans or similar educational intentions in light of what we know about learning processes and retention of information (pg.1-2). Wilson believed that effective curriculum and instructional planning could use both divergent and convergent thinking as initial ideas to generate a broad set of instructional patterns. He suggested that use of the general problem solving models might be effective when working with curriculum and instructional planning (pg. 1).

Tyler (1949) offered suggestions for developing curriculum and instruction that include defining the purposes of the school. Tyler explained that curriculum and instructional planning involves thinking about, and justifying what we are hoping to teach and how this material is relevant to the common and current purposes of school. Kliebard (1976) added that the greatest value of curriculum and instructional planning lies not in providing us with answers, but with daring us to challenge the questions that our intellectual educators have willed us. He said curriculum and instruction planning represents ways of addressing questions of what should be taught and why (pg. 2). Kliebard believed that it consists of efforts over many centuries to deal with certain timeless questions that have surrounded the practice of teaching, learning and the institution (pg. 1-2).

Wilson (2002) stated that curriculum and instructional planning requires that we relate educational experiences to our purposes, content, processes and methods to be used to deliver instruction and information. He added that we must know the organizational methods, which would be used in relation to those purposes, and how those purposes would be evaluated.

The essence, according to Wilson (2002), is to know that we have taught the content or process successfully (pg. 1-2).

Kliebard maintained that maturity in fields of study means, in its significant sense, a consciousness of who one is and where one stands in relation to where one has been. He said it should exist as a kind of continuing dialogue among people, who have addressed themselves to the perplexing and persistent issues that serve to define the field of education. Kliebard believed that curriculum involves an awareness of the best of what educators have done in regard to issues (pg. 243).

Cantrall, et.al (2002) suggested that curriculum and instructional planning could be modified through extended teacher training to enable teachers to use new teaching methods and work collaboratively. He believed that the reason why we try to redesign the high school curriculum is because most teachers could be doing things differently (pg. 1-2). Kliebard explained that curriculum consists of the practices and ideas expressed by a particular group of educators who self-consciously identified themselves as curriculum specialists, whose goal is to develop a field of study called "curriculum". Kliebard added that the purpose of curriculum planners is to influence educational practice in certain ways. He said the curriculum is a series of questions that inevitably arise when one begins to think seriously about teaching. According to Kliebard, curriculum and instructional planning ranges from inquiries about purpose, such as what should be taught, to questions involving the relative merits of particular school subjects, and why we should teach them (pg. 246).

Basic Principles of Curriculum & Instruction

Schugurensky (2002) said any device that provides valid evidence regarding the progress of students toward educational objectives is appropriate. Schugurensky maintained that the

selection of evaluation techniques should be made in terms of the appropriateness of that technique for the kind of behavior to be appraised (Tyler, cited by Schugurensky, pg. 1). He said successful teaching and learning techniques could be determined through behavioral studies, and evaluation of student behaviors is an appropriate means for determining educational success or failure (pg. 1).

Cruickshank (2000) added that teacher character traits, what the teacher knows, what the teacher teaches, how the teacher teaches, what the teacher expects, how the teacher reacts to students, and how the teacher manages the classroom help students to benefit from classroom instruction and gain knowledge (pg. 3). Kliebard (1976) expressed that curriculum represents ways of addressing questions of what should be taught and why. Kliebard believed that curriculum consists of efforts over many centuries to deal with certain timeless questions that have surrounded the practice of teaching and the institution. According to Kliebard, curriculum involves an awareness of the best of what has been done in regard to these issues, as well as the worst - especially the worst (pg. 245).

Schugurensky (2002) had the opinion that the relevance of behavioral objectives to the teaching process should lean towards students' classroom behavior, because such objectives would mark the cornerstone of curriculum decision-making and teaching strategies. He recommended four basic principles in the development of any curricular project to include defining appropriate learning objectives, establishing useful learning experiences, organizing learning experiences to have a maximum cumulative effect, and evaluation of the curriculum and revising those aspects that did not prove to be effective (pg. 2-40).

Curriculum: The Continuing Revolution

Smith (1976) believed that curriculum design was a powerful force in the educational system. According to Smith. the content and mode of instruction of the curriculum will be effective when it is adjusted to the nature and development of the learner. Smith added that the search for curriculum reconstruction has led to new curriculum approaches and to new types of classroom organization. daily programs. use of new materials. and modes of instruction. administrative structures and procedures. and evaluation of student progress (pg. 243).

Smith was of the opinion that innovative educators search for what program. content. best method and form of control to use so that they can be successful with children and youth. Smith believed that the curriculum can only be effective. no matter what changes are made in it. if it is reinforced by active engagement of the functions by which society is sustained. He said concepts such as "the child-centered school. project method. activity curriculum. core curriculum. and alternative school. stimulate those who seek a better curriculum. Smith added that the total burden of molding a child has become a task the teaching profession should take seriously. because the teacher is the one that determines how adjustment of the curriculum and all it entails will be advanced further towards the growth of the learner (pg. 244).

In what Stengeuthor (2000) described as "Dewey on methods". there is a belief that education is "a process of living" and school "a social life" designed to address student's needs. Stengeluthor said Dewey (1897) wrote that every successful teacher unconsciously or consciously uses methods of instruction in teaching. which include: planning. setting objectives. motivation for learning. classroom management. student-centered instruction.

cooperative learning, inquiry approaches, literacy skills, or assessment. Of all these strategies to facilitate learning, Dewey argued that the law of presenting any material is the one reduced within the level and development of the learner (pg. 2).

Smith (1976) indicated that if our society can restore and enrich its educative influence by involving children and youth, curriculum development will progress. He explained that we were in a new era in which exploration of the human mind and educational potential can lead to changes hardly imaginable in the learner. Smith felt that issues about conditioning and reinforcement, behavioral objectives and curriculum design would become a problem of the past, when the curriculum issues of learning and teaching were adjusted. He believed that curriculum development was at the heart of schools, and it will continue to be a seminal force in the evolution of the process of schooling (pg. 244).

Instructional Design

Stirling (2002) stated that in the education sector, it is becoming increasingly apparent to scientifically oriented educators that education must discard the folklore approach to instruction and move forward to new frontiers, which include the development of instructional systems based on behavioral science theory, research, and development. He explained that practice is the key to learning, and learning occurs when the topic is carefully controlled and sequenced and students are appropriately reinforced (pg.1).

Boydston (2000) added that the school is an extension of civil society, where the student is encouraged to operate as a member of a community, actively pursuing interests in cooperation with others. He believed that it is by this process of self-directed learning, guided by the cultural resources provided by teachers, that a child is best prepared for the demands of responsible membership within the democratic community (pg. 1-10).

Boydston (2000) attested that school, society, democracy, and education work together to constitute human advancement that a child needs in the life process. He believed that the individual is a social being from the start, and that individual satisfaction and achievement can be realized only within the context of social habits and institutions that promote it (pg. 9). He recommended research, training, and practice as a tool to encourage learning (pg. 2).

Contextual Teaching & Learning

The U.S. Department of Education (USDA) and the National School-to-Work Office (2002) in a recent report indicated that any educational model that recuperates the mind would be considered excellent in learning and teaching. It is believed that contextual teaching and learning includes: emphasis on problem-solving, recognition of the need for teaching and learning to occur in a variety of contexts such as the home, community, and work sites, teaching students to monitor and direct their own learning so they become self-regulated learners, anchor teaching in students' diverse life-contexts, encourage students to learn from each other and together, and employ authentic assessment (pg. 1).

The USDA defined contextual teaching and learning as a conception of teaching and learning that helps teachers to relate subject matter content to real world situations that motivates students to make connections between knowledge and its applications to their lives as family members, citizens, and workers so that they could actively engage in the work that learning requires (pg. 1).

This model suggests that teacher education programs must justify and build consensus around fundamental concepts, objectives of the education program, the role of the teacher, the nature of teaching and learning, and the mission of schools in a democracy (pg. 1). The model recommends that curriculum and instruction should include the development of skills,

competencies, and academic knowledge transmitted to students through activities, field experiences, and events constituting the instructional techniques and approaches modeled by the teachers, and the various contexts (classrooms, laboratories, community, workplaces) in which the student learning occurs (pg. 1).

What is Sustainable Agriculture?

Gold (2002) explained sustainable agriculture as a system that tries to accommodate the basic needs of present inhabitants while preserving the resources for future generations. Gold said United States Department of Agriculture (USDA) is committed to working toward economic, environmental, and social sustainability of diverse food, fiber, agriculture, forest, and range system. Gold believed that USDA would make efforts to balance goals of improved production and profitability, stewardship of the natural resource base and ecological systems, and enhancement of the vitality of rural communities. According to Gold, USDA would integrate these goals into its policies and programs, particularly through collaboration, partnership, teaching, research, and outreach (pg. 3).

Jackson and Gilman (2000) explained the system as a non-workable concept, and believed that our knowledge base for shifting from monocultural practices to a sustainable agricultural system would meet obstacles. In their own words, Jackson and Gilman (1986) said:

> We don't know if we can say where we are except that there seems to be a growing interest and awareness of this type of stuff, and clearly the industry paradigm for agriculture is coming under very high surveillance by a lot of alternative type folk, and it comes just at a time when farmers are in deep trouble. So the good thing about that is that a lot of people that have given farmers this industrialized agriculture have been softened by the economic plight and are a little more willing to listen. It's a kind of reluctant listening, but there are people that are willing to listen (pg. 7).

Baker (2002) said the sustainable agriculture working group (SAWG) is a collection of people that believe they have a keen interest in sustainable agriculture. According to Baker

(2002), this work group, originally comprised of University Outreach and Extension field staff, who have been together for years, and utilized a list serve as a forum and information sharing tool. Recently, Baker explained that these groups have opened discussions to a wider public by extending an invitation to join their list-serve as educators, farmers, or consumers. Baker believed that the motive is to expand the audience, enhance learning, and further sustainable agricultural initiatives (pg. 3).

Bushnell (2002) said Americans nationwide are becoming increasingly concerned about social and environmental farm issues such as food safety and quality, surface and ground water contamination, biotechnology applications, and natural resource management. Bushnell (2002) added that soil erosion, increased international competition, and changing consumer preferences are also contributing to the need for a more balanced and sustainable American agricultural system (pg. 3).

Sustainable Agriculture: Definition and Concepts

Keeney (1990) believed that the confusion over the terms and concepts of agricultural sustainability is inhibiting cooperative progress toward long-term minimization of the off-site environmental effects and negative social/economic impacts of some of today's agricultural practices. Keeney (1990) attempted to clarify the concepts and terminology of sustainable agriculture in an effort to facilitate communication, but remarked that a working definition of sustainability will come with time as research and practice enable more precise evaluation of the concepts and components of agricultural sustainability (pg. 3).

Duffy (2002) stated that the basis of most U.S. agricultural research has been to increase production and improve efficiency, where efficiency has been measured in terms of output per worker. With reference to conventional agricultural system, Duffy (2002) believed that

when we have a policy that favors one type of production system over another, we are going to bear the consequences. According to Duffy, when we pursue one research agenda, we preclude other agendas. He stated that the natural world works in cycles and systems and humans are part of the natural system. Duffy argued that we cannot demise of a particular species, and what happens to one specie, no matter how far removed from us, could have an impact on our existence (pg. 1-7).

Keeney (1991) agreed that people are aware of the need to change the nation's land ethic due to the problems such as soil erosion, water pollution, loss of wetlands, and biological diversity. Keeney (1991) questioned how we can preserve natural resources without threatening national or global food security and farm income (pg. 1-2). A report from the Leopold Center (1994) explained that farmers use three general learning techniques in considering practice change, and these include informational learning through exposure to and gathering of information, observational learning through examination of on-site farm practices, and experiential learning through implementation, correcting mistakes, and additional practice (pg. 5- 8).

An Introduction to Sustainable Agriculture

The Committee for Ecological Agriculture Project (2001) explained sustainable agriculture as a philosophy and a system of farming with a set of values that has both ecological and social realities. This committee said sustainable agriculture involves design and management procedures that work with natural processes to conserve all resources, maximize waste and environmental damage, while maintaining or improving farm profitability.

The Committee said sustainable agriculture systems take advantage of existing soil nutrient and water cycles, energy flows, and soil organisms to produce food that is nutritious. The Committee believed that such a system would avoid use of synthetically compounded fertilizers, pesticides, growth regulators, and livestock feed additive substances that depend on non-renewable resources, because they disrupt potentials within the environment, impacts wildlife, livestock and human health (pg. 1).

The Committee added that sustainable agriculture systems rely on crop rotations, crop residues, animal manure, legumes, green manure, off-farm organic wastes, appropriate mechanical cultivation, and mineral bearing rocks to maximize soil biological activity for soil fertility and productivity. They said natural, biological, and cultural controls help to manage pests, weeds and diseases. The Committee believed that the degree to which different models of farms are sustainable is variable, and dependent on the talent and commitment of the farmer. They explained that sustainable agriculture has been practiced for many decades, and its success depends on many approaches of efficiency and the skills and attitudes of the producers (pg. 1-2).

Defining and Implementing Sustainable Agriculture

Norman et. al (2000) said there are many proposed definitions of sustainable agriculture, but the first adopted in the U.S. by the American Society of Agronomy (1989) stated that "a sustainable agriculture is one that, over the long term, enhances environmental quality and the resource base on which agriculture depends; provides for basic human food and fiber needs; is economically viable; and enhances the quality of life for farmers and society as a whole" (pg. 15).

Norman et.al (2000) explained sustainable agriculture to be an integrated system of plant and animal production practices having a site-specific application that over the long run would: satisfy human food and fiber needs and enhance environmental quality and the natural resource base upon which the agricultural economy depends. Norman et.al added that sustainable agriculture would make the most efficient use of nonrenewable resources and on-farm resources and integrate. where appropriate. natural biological cycles and controls. sustain the economic viability of farm operations. and enhance the quality of life for farmers and society as a whole (pg. 4).

Norman et.al (2000) noted that many farmers recognize the need to be directly concerned about the sustainability of agriculture. In the olden days. Norman et.al (2000) explained that increases in agricultural production involved bringing more land into cultivation. These days. Norman et.al (2000) observed that the rate at which new land is brought into cultivation has declined. In the 1970s. they said new cropland worldwide expanded at only 0.3% per year compared with a rate of 1% in the 1950s (Hanrahan et al. 1984. cited in Norman 2000). Norman et.al (2000) believed that future increases in agricultural production would come primarily from increasing output per unit of land rather than increasing the area cultivated (pg. 11).

Norman et.al (2000) explained that the definition of sustainable agriculture has five parts. emphasizing productivity. environmental quality. efficient use of nonrenewable resources. economic viability. and quality of life. They argued that a farm that emphasizes short-run profit. but sacrifices environmental quality. would not be sustainable in the long-run. On the other hand. pursuing environmental quality without ensuring viability of short-run returns would also be unsustainable. Norman et.al emphasized that a farm that is very productive

but uses large quantities of nonrenewable resources. such as fossil fuel to achieve and maintain that productivity would not be considered sustainable in the long run.

In the wake of all these complexities. Norman et.al (2000) added that increasing farm production through use of chemicals could accelerate ecological problems. They believed that increasing energy costs per bushel of crop produced (including energy to make the chemicals and machinery) in the face of declining fossil energy reserves. could make the output/input energy ratios to become progressively less favorable. They held that success in moving towards sustainable agriculture would depend on using the limited nonrenewable resources (e.g.. fossil energy fuels. certain chemicals) as sparingly as possible and getting maximum return from the application by using the biological cycles that exist in nature and are largely ignored in present-day agriculture.

Sustainable Agriculture in the U.S.

Cantrall et. al (2000) said sustainable agriculture in America is more of a concept than a specific definable practice. According to Cantrall. sustainable agriculture in America attempts to manage all resources. not only the target crop. They explained that sustainable agriculture in America can be achieved through a variety of practices and theories. including crop rotations: water. soil. and air conservation: wildlife and pest management: and conservation of biodiversity (pg. 1).

Guthrie (2001) believed that sustainable agriculture is the future of all agriculture. being all-inclusive and incorporating the most modern technologies as well as simple lessons learned from backyard gardening. Guthrie added that sustainable agriculture would continue to revive and revise past farming practices. including those concepts that would allow us to

comprehend the complexity of agriculture and the integration of our food and farming systems (pg. 1).

Drommond et.al (2000) argued that a precise definition of sustainable agriculture is elusive, and probably always will be due to the fact that the concept of sustainability is so dramatically different depending on the aspect in which it is viewed. Drommond et.al believed that a comprehensive definition of sustainability must include physical, biological, and socioeconomic components. He defined sustainable agriculture as being represented by farming systems in which the use of purchased chemical-based inputs is significantly decreased in comparison to conventional agricultural systems, soil erosion is controlled and weeds managed, there is maximum efficiency of on-farm and purchased inputs, a maintenance of soil fertility by proper addition of plant nutrients, and the basic utilization of biological principles throughout the farming operation (pg. 2).

In practicing sustainable agriculture, Cantrall et.al 2000) said the output should not be the most important element, but the entire process of attaining that yield. They added that sustainable agriculture practices lead to long-term productivity, and it means using natural resources wisely while at the same time protecting the environment (pg. 1-2).

Cantrall et.al (2000) affirmed that sustainable agriculture would become a strategy when it is used to achieve a clean low cost environment. They said "it's all about balance between agricultural pests and their enemies, a balance between inputs and outputs" (pg. 1), and a look at nature and agriculture and realize the crop field is an ecosystem (pg. 2). To make sustainable agriculture a success, Cantrall et.al believed that "we must care for the means as much as we do for the ends" and respect land rather than molding it to fit our needs" (pg. 2).

Cantrall et.al suggested that increased crop rotation, reducing dependence on chemicals, and reducing tillage are specific practices that must be integrated into the current custom. He added that we must develop networks to enable farmers to receive this information, so that we could jointly analyze and evaluate new technologies that would be both environmentally stable and competitive (pg. 2).

Cantrall et.al felt that we must provide technical training for people working towards sustainable agriculture, if agriculturists are willing to make the changes to become more sustainable. They acknowledged the role of research, education, technology development, and testing for various chemicals would help in promoting the goals of sustainable agriculture (pg. 2). If many sustainable practices were implemented, Cantrall et.al believed that costs would go down, pesticide costs could reduce, soil erosion, water pollution, and nitrogen use could go down, and our farms would become more natural. Cantrall et.al believed that the strategy in achieving agricultural sustainability would be keeping farms small and family-run.

Cantrall et.al opposed conventional agriculture, and said its benefits are deceiving in the long-run. They believed that conventional agriculture does not guarantee high productivity and does not sustain the high yields produced with the chemical and technological aids. Though yield may rise through intensive agriculture, Cantrall et.al believed that the nutritional level would fall. In order to encourage the practice of sustainable agriculture, Cantrall et.al maintained that rotation and diversity are key principles in a sustainable farming system. They believed that we could promote the specific sustainable agriculture practices by using mulching with organic material, use of legumes as nitrogen fixers in cover crops or in crop rotations, and weed management (pg. 5).

Sustainable Agriculture Curricula: K-12

Adam (2000) reported that there is need for more information for teachers to supplement curricula related to sustainable agriculture and resource conservation. because not much has been produced in this area. Adam explained that the first and only complete sustainable agriculture curriculum was published in 1991. in Wisconsin. designed primarily for high schools in that state. Adam explained that other information about sustainable agriculture is designed to provide videos. conference audio tapes. and other audiovisual materials. She said very little has been published in the way of K-12 curricula targeting sustainable agriculture specifically as distinguished from agriculture appreciation materials (pg. 1-2).

Adam believed that organic agriculture was becoming the best known form of sustainable agriculture. and suggested that a curriculum guide that would provide learning opportunities in sustainable agriculture would be essential (pg. 1-2). Adam said students would have more opportunities to learn about sustainable agricultural practices if there are resources related to sustainable agriculture curricula to provide information for continuing education and appropriate technology transfer. She believed that a curriculum model that does not address this problem would be inadequate to new paradigms of farming. education. and information management (pg. 2-3).

Adam explained that. so far. some sustainable agriculture curricula and resources available were in the areas of "farming with foresight". "saving farm animal breeds from extinction". "worms eat our garbage: classroom activities for better environment". "integrated pest management and biological control in agriculture". and "horticulture" (pg. 2-5). The Committee on ecological agriculture projects (2001) said sustainable agriculture is both a

philosophy and a system of farming, that has its roots in set values that reflects an awareness of both ecological and social realities (pg. 1).

Teaching Tomorrow's Agriculture Today: A New Vision for the Agricultural Industry

Williams (1997) said increased population and policies that limit the cultivation of certain pieces of land made sustainable agricultural practices a concern. According to Willaims, the 1980's was a time of change in U.S. agriculture, because farmers and researchers were seeking innovative ways to reduce costs and protect human health and the environment. By 1990, Williams said sustainable agriculture had become a world-wide issue due to the growing awareness that agricultural systems must provide not only what humanity needs today but what the human family will require a decade or even a century from now (pg. 10)

Williams (1997) explained sustainable agriculture to mean an integrated set of technologies, practices and systems developed in response to problems facing agriculture. According to Williams, the goal is to manage agricultural systems so that inputs and returns are optimized while protecting the environment. As a result, Williams (1997) reported that a Joint Committee on Sustainable Agriculture (1991, pg. 4) developed farming systems that are "economically sound, socially acceptable and environmentally benign", with the aim of providing a system that would offer profitability for farmers, provide safe food, protect natural resources, and depend more on renewable resources (pg.10).

Williams (1997) added that sustainable agriculture would support a high quality of life for farmers, provide adequate economic return to the farm, protect the environment, support alternative production systems, and recognize the increasing global interdependencies of agriculture. He believed that sustainable practices were being used to produce a wide variety

of agricultural products across the U.S., especially in Ohio, Iowa, Virginia, Pennsylvania, California, Florida, Arizona, and Colorado. Williams believed that agricultural education in secondary schools could be a partner in developing the agricultural industry in the 21st century.

He explained that sustainable agriculture provides futuristic direction for the secondary school agricultural education curriculum, and added that this new area of science and technology would provide vitality to the curriculum and serve new students not otherwise enrolled in agricultural education classes. In his opinion, agricultural education programs that offer instruction about profitability, safe food, quality of life, conservation of natural resources, protection of the environment, and global interdependence are teaching tomorrow's agriculture today (pg. 12).

Sustainable Food and Agriculture Systems: Concepts, Issues and Approaches

Smith (2001) reported that sustainable agriculture and related concepts have generated more discussion in land grant universities. According to Smith, agricultural colleges have modified their approach and philosophy to ensure long-term sustainability of the food and agriculture system. He explained that in 1989, a Task Force on Sustainable Agriculture was formed to address relevant local, national and international issues. Since then, Smith (2001) said colleges of agriculture have affirmed that its teaching, extension and research programs would continue to address important issues related to the viability and sustainability of agriculture (pg. 1).

Smith (2001) identified changes in the ways we deliver and conduct our teaching, extension and research programs, and believed that increased emphasis on interdisciplinary

approaches: collaboration and partnerships with relevant agencies and organizations would help teaching and learning programs. He said production agriculture would no longer be viewed in isolation, because successful teaching programs would require an understanding of the agricultural system as a significant part of the food system, environmental protection and community well-being.

Smith (2001) placed emphasis on program areas coordinated with teaching, extension and research, and believed that they should:

(1) Assist in developing and articulating the institutional philosophy, vision, mission, and goals for efforts addressing issues relating to the sustainability of food and agricultural systems;
(2) Ensure the integration of sustainable food and agriculture systems, issues, and concerns into ongoing teaching, extension and research programs;
(3) Identify and implement strategies to enhance and increase collaborative work on the sustainability of food and agricultural systems across disciplines and departments with public and private sector agencies, organizations, businesses and individuals, including farmers.

Smith (2001) believed that sustainable agricultural systems should ensure adequate profit for the farming sector, and enhance the environment, as well as being socially acceptable (pg. 1-2). Smith (2001) said ensuring the sustainability of food and agriculture systems is, and has always been important. He said issues related to sustainable food and agriculture play an important role in helping us to focus our thinking to further improve our research, teaching and extension activities, and to bring greater visibility to long-term sustainability of the food and agriculture systems at local, national and international levels as we look to the 21st century and beyond.

Smith drew his working definition of sustainable agriculture from the 1990 Farm Bill, that defines sustainable agriculture as "an integrated system of plant and animal production practices having a site-specific application which will, over the long term:

. Satisfy human food and fiber needs:
. Enhance environmental quality and the natural resource base:
. Make the most efficient use of nonrenewable resources:
. Integrate, where appropriate, natural biological cycles and controls:
. Sustain the economic viability of farms, and
. Enhance the quality of life for farmers and society as a whole".

Smith (2001) said the activities on sustainable agriculture have influenced programmatic efforts by fostering discussion and debate on programs and institutional issues related to the long-term sustainability of food and agricultural systems, and facilitating both faculty-and student-driven projects. He said one measure of the influence of sustainable agriculture in our programs is the amount of competitive grants given to colleges of agriculture from the Regional Sustainable Agriculture Research and Education Program (pg. 3).

Educational and Training Opportunities in Sustainable Agriculture

The United States Department of Agriculture (USDA) and Agricultural Research Service (2000) reported that there are educational and training opportunities in sustainable agriculture. The funding will be based on involvement in organic, alternative, or sustainable agriculture and a willingness to provide education and training, or to share specific information relating to the food and agricultural sciences. The Committee stated that projects should be designed to focus on farming systems that provide information about agricultural productivity and profitability, while protecting natural resources that include sustainable systems, low-input, regenerative, biodynamic, or organic farming and gardening (pg.2).

The Committee placed emphasis on demonstration plots, workshops, conservation practices, environmental information on pesticides, research on natural resources, crop protection, and water safety. There was also emphasis on education in managing natural and human resources to restore soils, plant and animal life, water resources and restoring our

environment. There was focus on environmental programs using organic and inorganic methods of plant growth. internships. use of technology. teaching. extension and outreach (pg. 3-7).

The Committee explained that there are several on-going research projects that are studying the transition from conventional to organic cropping systems and programs that focus on workshops. and training courses and materials on indigenous knowledge for agriculture and rural development. The Committee added that grassroots advocacy for sustainable agriculture including farmer organizing on resource conservation issues. public education on agriculture and its impact on the environment. and political advocacy to support small-scale farmers using indigenous materials are available from different organizations and institutions in the United States (pg. 4- 26)

Staff Development

Joyce et al (1987) believed that recent research on staff development and curriculum implementation has provided guidelines for the design of staff development programs that enable teachers to increase their repertoire of teaching skills dramatically and to use those skills effectively. Joyce et.al stated that there is a significant relationship between teacher training programs. competencies. affective climate and individual differences (pg. 351).

Joyce et.al said there is no better foundation for shared beliefs than knowledge about what kinds of learning and how much learning can be expected if the content of staff development is learned well and applied effectively. Joyce et.al added that research on innovation has indicated that sustained change in curriculum and instruction depends heavily on a shared understanding about the nature of the innovation and what it can accomplish. Joyce et.al (1987) believed that staff development programs have been created with curricula and

instructional improvement in mind, and said, the motivation to engage in staff development and implement its content depends on a desire to increase the power of education and a belief that it is feasible to do so (pg. 12).

In a study about making classroom management approaches in teacher education relevant, White (1995) explained that teacher education programs would be more effective if they went beyond certification to include inservice and practical assistance programs that address relevant curriculum and instructional approaches (pg. 15-16).

Yeatts (1976) stated that inservice education is an integral part of a school system's improvement plan that must take place prior to curriculum changes. Yeatts believed that this type of staff-development approach aims to ensure that participation in teacher-requested and designed inservice activities will result in lasting learning and ultimately produce improved, innovative educational programs for students (pg. 421).

Staff Development Services

Barr (2002) believed that staff development programs handles teachers' hard questions about teaching and learning, while giving them tools they need to work successfully with students. According to Barr (2002), staff development provides teachers with excellent training, especially to those teachers who wouldn't hesitate to express their dissatisfaction in teaching. When teachers meet for the purpose of inservice training, Barr maintained that such specialized programs helps teachers to believe in themselves particularly in communication, decision-making and team building. Barr emphasized that great teams are made up of knowledge people who have focused vision, mission, and can empower each other through their initiative and skill development (pg. 1-2).

Wisniewski (1986) believed that questions about the quality of teacher education could only be answered by examining those who prepare teachers. Wisniewski stated that commitment to scholarship must characterize those who prepare teachers. According to Wisniewski, an ideal teacher would be excited in learning and be capable of communicating this excitement to others. McKee (2002) stated that seminars and workshops serve as valuable resource to staff development especially at this changing time.

McKee (2002) said staff development gives teachers hope, because most of the used practical tools focus on unique experiences. Joyce and Showers (2002) illustrated that effective training should include theory, demonstration, practice, feedback, and classroom application. Mezirow (1991) perceived the role of the teachers as very important and stated that they must understand how to use learning resources, especially the experience of others, including the educator. Mezirow argued that educators should have training that would enable them to define learning objectives, planning learning programs, evaluating progress, decision-making, selection of relevant learning experiences, and facilitate the learner's perspectives.

Perceptions of Teachers and Students Regarding Sustainable Agriculture

Williams and Wise (1997) conducted a study that included all secondary school agricultural education programs in Iowa. The purpose was to determine the perceptions of Iowa agricultural education teachers and students about sustainable agriculture. The specific objectives were to determine teacher and student self-perceived knowledge of selected sustainable agriculture practices, and to determine the impact of sustainable agriculture as

perceived by teachers and students. Perceptions were measured related to knowledge and impact of sustainable agriculture.

Williams and Wise (1997) found that teachers perceived themselves as having additional things to learn about sustainable agriculture practices, and students were found to be "knowing little" about the concept. Students expressed some positive feelings about sustainable agricultural practices like "conservation of soil," "protection of groundwater," "protection of wildlife," and "safer food." Williams and Wise believed that both teachers and students perceived sustainable agriculture as impacting the environment in many ways (pg. 20).

Williams and Wise (1997) affirmed that inclusion of sustainable agriculture in the curriculum is essential, because there are strong public reactions and reports of water and food contaminated by agricultural practices, concerns for the health of people who live and work around pesticides, and reports of depletion of our natural resources, including soil, water, forests, wetlands, and native prairies (pg. 15).

Rowe (1994) argued that changes in academic curricula would be effective if they are reflected in all aspects of the institution's needs. He explained that market pressure for agricultural goods is the reason why there are problems of educating people on best environmental practices. Rowe believed that effecting real change in agricultural practices to reflect environmental protection could only be achieved when there is substantial economic support (pg. 105-107).

Perceptions about Sustainable Agriculture and Education

Gamon & Scofield (1998) described the sustainable agriculture as a movement that is an important one for educators because of increasing social concern about the effects of agriculture on the environment. Hakeem & Vemuri (1997, pg. 64) believed that the idea of achieving sustainability in agriculture has become a concern due to its political nature.

Gamon & Scofield explained that the consequences were greater management requirements and changes in equipment (pg. 63). People have different perceptions for sustainability (Hakeen & Vemuri, pg.64). They said some see it as strength while others see it as weakness. Hakeen & Vemuri added that sustainable agricultural practices could only be efficiently utilized if we can adequately link output, technological change, and resources. For sustainable agriculture to make sense, Hakeen & Vemuri were of the opinion that costs of adjustments must be paid for in their entirety, and changes to resource utilization accompanied by institutional adjustments (pg. 64).

Francis (1995, pg. 5-6) believed that one aspect of sustainable agriculture that has received little attention is the structure that each society establishes in order to provide for its agricultural needs. According to Francis, the structure of agricultural production has evolved in different ways around the world. Francis believed that production of agricultural products has been based on what is functional in each country and the social and political considerations that have been established in agricultural policy.

Gamon & Scofield (1998, pg. 63) said agricultural educators nationwide are interested in agricultural practices that are sustainable, because environmental influence has important implications on agricultural education. Their concern was how to find a good delivery method that would help to educate young producers to adopt sustainable agricultural

practices with minimum tillage and reduced use of chemicals. Gamon & Scofield analyzed the adoption model and explained that adopter categories determine people's readiness to adopt new practices.

Summary of Literature Review

Information from the review of literature indicates that sustainable agriculture has many different definitions. Some authors looked at the definition from the production point of view relating to food sufficiency, while others equated sustainability with stewardship as it applies to environmental relationships. High school agricultural education teachers have been encouraged to start their curriculum planning from objectives drawn from questions that surround the practice of sustainability. The literature review indicated that curriculum can be a powerful educational tool if it is learner-centered leaning towards the desires of the community.

The review of literature reminds agricultural education teachers that the school curriculum is in constant change, and indicated that teachers should be able to move with these changes if they engage themselves with workshops, research, and inservice education training programs. The review of literature indicated that there are not enough resources available on sustainable agriculture at this time. The review of literature indicated that the only curriculum resources available in sustainable agriculture seems to be focused on skills for farmers. Sustainability is a broad topic, and the review of literature supported the need for more information about sustainable agriculture in various forms, and that gives some indication for an expanded curriculum.

The review of literature also indicated support for agricultural education teachers developing competencies and validated knowledge bases through inservice education and

training. The literature indicated that agricultural education teachers have a lot to learn about sustainable agriculture. The literature review showed that sustainable agricultural practices may be new to the curriculum and teachers may not have enough experience to teach sustainable agriculture practices.

The review of literature indicated a need to conduct a study focused on the perceptions of teachers regarding their current use of sustainable agriculture practices in teaching students of agriculture. There was also a need to find answers to questions focused on inservice education in selected areas of the curriculum having to do with sustainable agriculture. This study was needed to either confirm previous findings or determine to what extent new information could be found to impact curriculum development. Therefore, the research questions were:

(1) What are the perceptions of secondary agricultural education teachers regarding basic teaching concepts for teaching sustainable agriculture in the twelve states of the North Central Region of the United States?

(2) To what extent do secondary school agriculture teachers teach selected sustainable agriculture skills and knowledge in their curricula?

(3) Do secondary agricultural education teachers in the North Central Region of the United States believe that inservice training is needed for selected areas of sustainable agriculture?

(4) Do demographic factors influence the teaching of sustainable agriculture in secondary agricultural education schools in the North Central Region of the United States?

(5) What type of "model" can be developed for guiding the successful infusion of sustainable agriculture within the secondary school agricultural education curriculum?

CHAPTER III. METHODS AND PROCEDURES

"Anything new should be questioned and tested with caution, for it may very easily turn out to be only a new disease" (Kliebard, 1976). The main purpose of this study was to: identify the perceptions of high school teachers of agriculture regarding teaching sustainable agriculture. The specific objectives of this study were to:

1. Identify perceptions of teachers regarding basic concepts of teaching sustainable agriculture.
2. Identify the extent to which teachers teach selected sustainable agriculture skills and knowledge.
3. Identify the extent to which inservice training is needed in selected areas of sustainable agriculture.
4. Identify demographic characteristics and their relationship with selected perceptions.
5. Develop a model for an inservice education program for teachers of agricultural education.

The methods and procedures for this study are presented in this chapter under the sub-headings: Research Design, Population and Sampling, Instrumentation, Data Collection, Data Analysis, Limitations of the Study, and Assumptions for the Study.

Research Design

The study used a descriptive design. A survey questionnaire was used to determine the perceptions of secondary school agricultural educators regarding teaching sustainable agriculture practices. A self-administered questionnaire was used to collect the data. The questionnaire was mailed to a randomly selected sample of agriculture teachers in the twelve states of the North Central Region of the United States. This method allowed for

the utilization of descriptive statistics as tools for organizing, simplifying, and summarizing basic information from an otherwise unwieldy mass of data (Hopkins et al., 1996, pg. 2 as cited in Agbaje, 1998). Also, the use of mail-back questionnaires offers substantial benefits to survey researchers such as reducing interview costs, saves time, convenience for respondents, enhances cooperation, prevents bias, and can reach unknown individuals within a space of time (Dillman et. al. 1995).

Population and Sample

The population for the study consisted of all secondary school agriculture teachers in the twelve states of the North Central Region of the United States namely, Illinois, Indiana,

Table 1. Distribution of respondents and the questionnaire return rates in the twelve states of the study.

States	No. Eligible	No. Sent	No. Returned	No. Analyzed	% Responding
Illinois	309	77	36	35	45%
Indiana	174	49	15	15	31%
Iowa	237	59	30	30	51%
Kansas	158	40	21	20	50%
Michigan	117	29	16	16	55%
Minnesota	192	48	12	12	25%
Missouri	285	72	26	26	36 %
Nebraska	127	32	10	10	31%
N. Dakota	85	21	9	9	43%
Ohio	364	91	41	40	44%
S. Dakota	83	21	7	7	33%
Wisconsin	260	65	24	24	37%
Total	600	600	249	246	41%

Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin. The defined population was a total of 2395 teachers as listed in the Agricultural Educator's Directory, 2000.

Using a formula to determine sample size as suggested by Agresti, and Finlay (1997), the suggested sample size was 599. The basis for inferential power lies in the formulas for the standard errors of the sample point estimates (which actually treat the population size as infinite (pg. 135-137). To be accurate to within plus or minus 4 percentage points, with a 95% confidence level assuming the worst case scenario of only a coin's flip probability (50%) of an outcome on any given question, a sample size of 600 provides a conservative amount of information yielding an acceptable margin of error, assuming a random sample (Shelley, 2002). Table 1 presents the distribution of the respondents and the number of questionnaires returned and analyzed for the twelve states in the North Central Region included in this study.

Instrumentation

The instrumentation for the study was developed by the researcher to identify the perceptions of high school teachers of agriculture regarding teaching sustainable agriculture. The instrument (Appendix C) was composed of four parts. Part A contained 10 perception statements regarding basic concepts of teaching sustainable agriculture to agricultural secondary school students. Part B focused on 15 skills and knowledge bases in sustainable agriculture and the extent to which they were taught to students. Part C focused on the extent to which inservice training was needed related to areas of sustainable agriculture. Part D contained 8 demographic items.

In order to assess the responses, part A utilized a 5-point Likert-type scale (1-5) concerning perceptions regarding basic teaching concepts of sustainable agriculture. The scale range was: 1=Strongly Disagree (SD); 2=Disagree (D); 3=Neutral (N); 4=Agree(A), and 5=Strongly Agree (SA). Also, a 5-point Likert-type scale (1-5) was used in part B that focused on extent to which selected skills and knowledge bases in sustainable agriculture were being taught. The scale descriptors were: 1=None; 2=Low; 3=Moderate; 4=High, and 5=Very High.

Part C measured the extent to which inservice training was needed in selected areas related to sustainable agriculture. A Likert-type scale was used with descriptors being 1=No training needed; 2=Very little training needed; 3=Some training needed; 4=Moderate amount of training needed; and 5=Much training needed. Part D required information about respondents' gender, age, years of experience, nature of inservice training attended, and educational level. A field-test of the instrument was conducted prior to the study. The results of this test are in chapter 4.

Data Collection

Data collection was done by use of a self-administered instrument. The Iowa State University Human Subjects Review Committee approved the questionnaire (Appendix A), and cover letter (Appendix B). In order to maintain confidentiality, a code number was assigned to each questionnaire to keep track of the responses. Equally, it helped to identify those teachers that needed a letter of reminder.

On August 28, 2001, 600 instruments were mailed (Appendix C), with the cover letter (Appendix D) to the teachers. The purpose of the study was stated and respondents were told that participation was voluntary. A self-addressed stamped return envelop was also enclosed

in each package to facilitate a response. Due to a low response rate, a reminder letter (Appendix E) was sent to non-respondents on September 27, 2001. At the end of October, a total of 249 questionnaires were received and data collection ended. Out of the 249 questionnaires that were received, 246 were usable, which gave a usable response rate of 41 percent. A comparison between early and late respondents did not indicate any statistically significant or practical significant differences in the results. The respondents reflected the population as a whole.

Data Analysis

The usable data were analyzed using the Statistical Package for Social Sciences (SPSS) Program in the Iowa State University facility. Cronbach's alpha measure of reliability was used to determine internal consistency of the instrument. The frequencies, means and standard deviations were used to describe the following variables:

1. Perceptions regarding basic teaching concepts.
2. Extent to which selected skills and knowledge in sustainable agriculture were being taught
3. Extent to which inservice training is needed in selected areas related to sustainable agriculture
4. Demographic characteristics

   The SPSS independent sample t-test, One Way Analysis of Variance (ANOVA), or Pearson correlation were used to test for any significant differences that might exist in the perceptions of teachers based on their: gender, age, years of teaching experience, inservice attendance, highest level of education, where grew up, farming experience.

The independent sample t-test was used because it tests for differences in means between two groups and adjusts for situations in which variances between the two groups are unequal.

Limitations of the Study

The study was conducted with the following limitations:

1. The study focused only on the teachers from the twelve states in the North Central Region of the United States comprising Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin.
2. The study was limited to secondary school teachers of agriculture.
3. Some teachers of agriculture teach a variety of courses and some specialize in food science, production, processing, sales & services floriculture, horticulture, agriculture business, natural resources and conservation. Therefore, all teachers may not relate to sustainability issues in a similar manner.
4. The focus of the study was the teaching process. Sustainability in crop production and soil management provided the agricultural context for the study.

Assumptions for the Study

The following assumptions were made:

1. Secondary school agriculture teachers have some knowledge about the topic of sustainable agriculture and related practices.
2. Teachers are prepared to some extent to integrate sustainable agriculture into their secondary agricultural education curriculum.

3. The questions in the questionnaire were clear enough for teachers to understand and respond to them accurately according to their perceptions.
4. Collected data represented the views and the genuine perceptions of the secondary school agriculture teachers.
5. The findings of this study would assist high school agricultural education teachers in their decisions and curriculum planning about teaching sustainable agriculture.

CHAPTER IV. FINDINGS

The main purpose of this study was to identify perceptions of high school teachers of agriculture regarding teaching sustainable agriculture.

The specific objectives for this study were to: (1) identify perceptions of teachers regarding basic concepts of teaching sustainable agriculture: (2) identify the extent to which selected sustainable agriculture skills and knowledge are being taught: (3) identify the extent to which inservice training is needed in selected areas of sustainable agriculture: (4) identify demographic characteristics and their relationship with selected perceptions. and (5) develop a model for inservice education program for teachers of agricultural education.

The data were analyzed with the results reported in the following sections: (1) validity test. (2) reliability tests (3) demographic characteristics. (4) perceptions regarding basic concepts of teaching sustainable agriculture. (5) skills and knowledge in sustainable agriculture being taught (6) extent to which inservice training is needed.

Validity Test

Validity involves repeatedly hitting the heart of the target. which shows a measure of both validity and reliability (Krathwohl. 1998). In order to establish content validity. the instrument used was reviewed by the researcher. the plan of study committee members. an agricultural education professor. two doctoral students. and one master's degree student. all from Iowa State University. Clarity and readability of the instrument were improved after this review. The purpose of checking for validity is to find out if some items are wrongly worded. too easy or too hard for the recipients of the questionnaire (Krathwohl. 1998). The instrument was then sent to 73 randomly selected high school teachers of agriculture (not

included in the sample) in the North Central Region of the United States for a pilot-test. Out of this mailing, 16 (21.9%) were returned for review.

As a result of examining the results of the pilot-test survey, the survey instrument was changed. The number of items in Section A (perceptions regarding basic concepts of teaching sustainable agriculture) was decreased from 15 to 10 items. The number of items in Section B (extent to which skills and knowledge about sustainable agriculture were taught) was increased from 14 to 15. The number of items in Section C (extent to which inservice training was needed) remained at 10. Also, an eight item demographic section was added to Section D, and a page was included for open-ended general comments. In addition, the wording was changed in some of the items.

Reliability Tests

A check for the reliability refers to the consistency of measurement, the extent to which the results are similar over different forms of the same instrument of data collection. The goal of developing reliable measures is to minimize the influence on the scores of chance or other variables unrelated to the intent of the measure. Evidence should be shown of reliability to establish the level of reliability attained (McMillan & Schumacher 1997, pg. 178-179). The Cronbach's alpha measure of reliability was used to determine consistency of the instrument. The items were entered into three groups for the analysis of reliability as shown in Table 2.

The items in section A of the questionnaire which focused on the teachers' perceptions regarding basic concepts of teaching sustainable agriculture had a Cronbach's alpha coafficient value of .85. Section B, which focused on the extent to which selected sustainable

Table 2. Results of reliability tests for the instrument.

Groups of items for instrument	Number of items in each group	Cronbach's Alpha coefficient
Perceptions regarding basic teaching concepts sustainable agriculture.	10	.8456
Extent to which selected skills and knowledge about sustainable agriculture were taught	15	.9183
Extent to which inservice training is needed in selected areas	10	.8962

agriculture skills and knowledge were taught had a Cronbach's alpha coafficient value of .92. Group C examined the extent to which inservice training was needed in selected areas related to sustainable agriculture and had a Cronbach's alpha value of .90. McMillan and Schumacher (1997) stated that The Cronbach Alpha is generally the most appropriate type of reliability for survey research and other questionnaires in which there is a range of possible answers for each item (pg. 242).

Demographic Information of the Respondents

The study focused on the twelve states of the North Central Region of the United States. These states are: Illinois. Indiana. Iowa. Kansas. Michigan. Minnesota. Missouri. Nebraska. North Dakota. Ohio. South Dakota. and Wisconsin. The demographic information of the agricultural education teachers that participated in the study is provided in this section. A total number of 600 survey questionnaires were sent to these randomly selected teachers and 246 usable instruments were received. The demographic items included gender. age. years of teaching experience. number of times teachers have attended inservice education. highest level of education. where teachers grew up. and farming experiences.

Gender

Out of the 246 teachers that responded to the survey instrument, 199(81%) were males, while 47(19%) were females as shown in Figure 1. Agbaje (1998) found a similar trend in her study on perceptions of secondary school agriculture teachers in the North Central Region. In her case, 27(9.2%) were females, while 264(90.7%) were males.

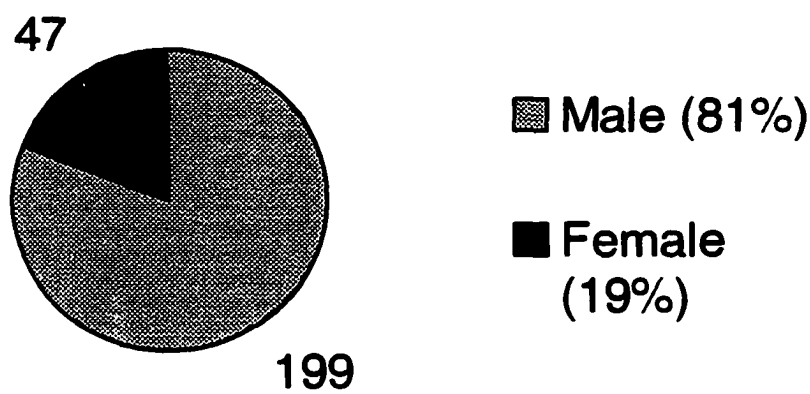

Figure 1. Distribution of teachers by gender (n=246)

Distribution of teachers by age groups

Teachers were grouped by age with twenty two (9%) teachers aged 25 years or less; 65(26%) teachers were between 26 to 35 years old; 87(35%) were between 36 and 45 years old, 63(26%) were between 46 and 55 years old; and 9(4%) were between 56 and 65 years old as shown in Figure 2. The mean value of their age was 39.5.

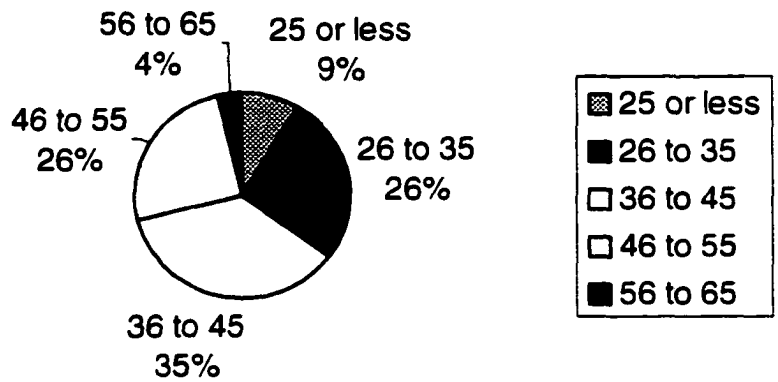

Figure 2. Distribution of teachers by age group (n=246)

Number of years of experience teaching agriculture

The distribution of the respondents by the number of years they had been teaching agriculture is represented in Figure 3. Out of the 246 respondents, one hundred nineteen teachers (48%) reported they had been teaching agriculture for 9 or less years; 74(30%) teachers had been teaching between 10 and 19 years; 48(20%) teachers had been teaching between 20 and 29 years; while 5(2%) teachers had been teaching between 30 and 39 years as shown in Figure 3.

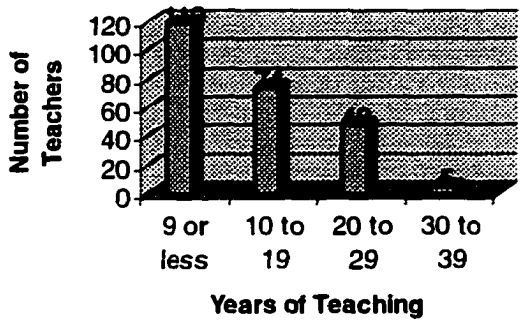

Figure 3. Distribution of teachers by number of years of teaching agriculture (n=246)

Teaching experience by number of years teaching

The number of secondary school agricultural education teachers that completed the questionnaire was 246. Out of this number, ninety-nine (40%) teachers said they had been teaching for about 10 years or less; 97(39%) respondents had been teaching between 11 and 21 years; 45(18%) of the teachers had been teaching between 22 and 31 years, while only 5(2%) of the teachers had been teaching between 32 and 42 years as shown in Figure 4. The mean value of their experience was 14.1 years.

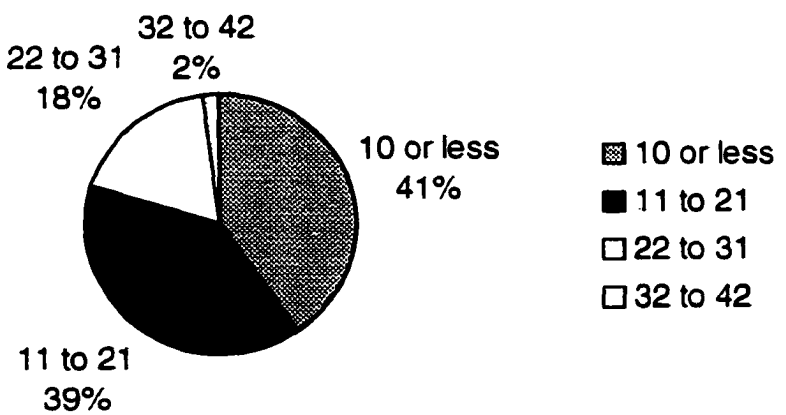

Figure 4. Distribution of teachers by number of years of teaching experience (n=246)

Number of inservice education programs attended

Figure 5 represents the distribution of high school agricultural education teacher attending an inservice education program on sustainable agriculture. Out of the 246 teachers that responded to the questionnaire, 165(67%) teachers reported that they had not attended any in-service education program on sustainable agriculture practices, while 81(32.9%) or about one-third, of the teachers said they had attended some form of inservice education program related to sustainable agriculture.

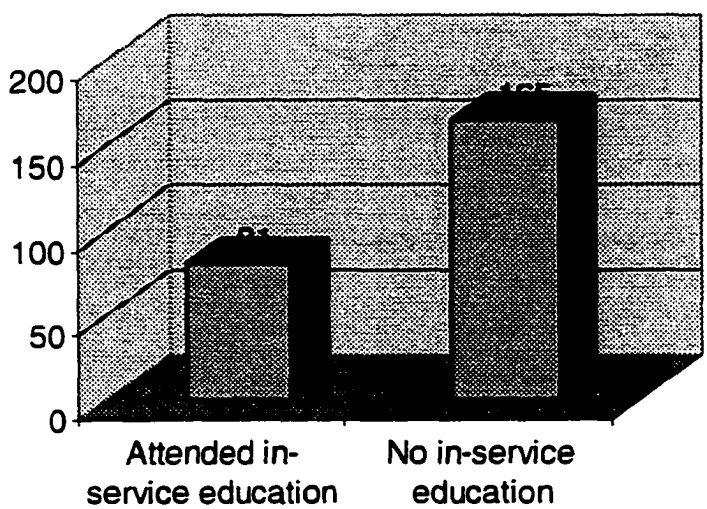

Figure 5. Distribution of agricultural education teachers by number of inservice programs attended focused on sustainable agriculture (n=246)

Educational level of teachers

One hundred forty-four (59.8%) respondents had a Bachelor of Science degree; while 98(39.8%) teachers had a Master of Science degree. No teacher had an Ed.D. degree, while one (.4%) respondent had a Ph.D. The data are shown in Figure 6.

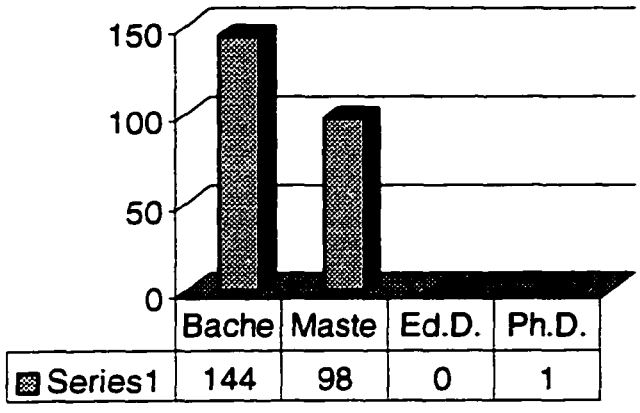

Figure 6. Distribution of agriculture teachers by educational degree level

Farming experience of teachers

All of the respondents had a diversified knowledge about farming acquired from a combination of sources. Many said they grew up and worked with their parents on the farm, while others worked as a laborer on a farm. Teachers gained knowledge through farming experiences related to growing crops and managing livestock. Many of the teachers gained knowledge by working on various diversified farms, school farms, research farms and Extension activities.

Six (2%) teachers gained experience through soil testing, soil conservation, erosion control, and irrigation practices. 102(42%) teachers had experience through animal production, while 17(7%) teachers gained experience in school.

Where teachers grew up

The agriculture teachers were asked to indicate where they were raised. Out of the 246 responses, 215(88.1%) or nearly 90% of the teachers reported they had grown up on the farm. Nineteen (7.8%) teachers indicated they had grown up in a rural non-farm area, while 10(4.1%) respondents indicated that they grew up in an urban area. Two respondents did not

indicate where they grew up. Figure 7 is a representation of agricultural education teachers by where they were raised.

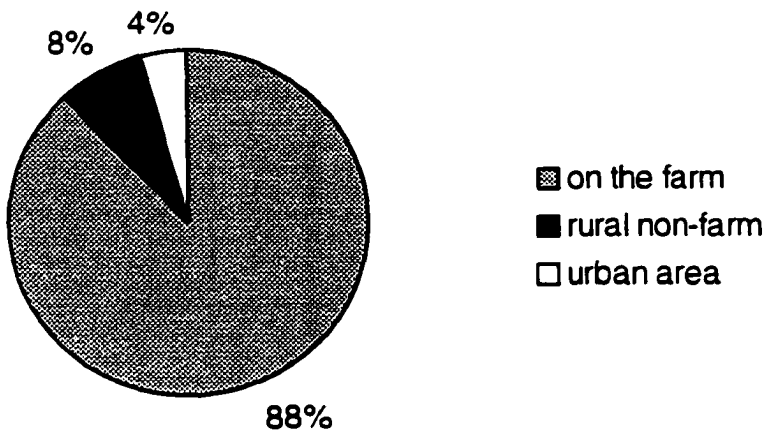

Figure 7. Distribution of teachers by where they were raised (n=246)

Perceptions of respondents regarding basic concepts of teaching sustainable agriculture

A teacher's perception is viewed as a professional and personal judgement and understanding regarding an event, issue, concept, or condition based on knowledge and experience or that of others. In this section, the perceptions of agricultural education teachers regarding basic concepts of teaching sustainable agriculture are presented.

In order to solicit information from high school agricultural education teachers about their perceptions regarding basic concepts of teaching sustainable agriculture, ten questions were used. The respondents were asked to indicate their level of agreement on a five-point Likert-type scale, with 1=Strongly Disagree, 2=Disagree, 3=Neutral, 4=Agree, and 5=Strongly Agree, as shown in Table 3. As a whole, teachers seemed to agree to items 1-6. Teachers

Table 3. Means and standard deviations of secondary school teachers of agriculture perceptions regarding basic concepts of teaching sustainable agriculture (n=246).

Perception Statements	n	M	S.D.
1. A variety of methods could be used to teach sustainable agriculture	246	4.24	.75
2. Teaching the definition of sustainable agriculture is a critical step in learning about sustainability	246	4.12	.84
3. Teaching about sustainable agriculture would add balance to the curriculum	246	3.88	.78
4. Sustainable agriculture practices should be incorporated into all areas of study in agriculture	246	3.82	.90
5. It would be easy to infuse sustainable agriculture into the curriculum	246	3.76	.93
6. Sustainable agriculture should be taught as a unit of instruction	246	3.50	1.04
7. Teaching sustainable agriculture is an important part of my curriculum	246	3.42	1.19
8. Teaching sustainable agriculture is the same as teaching conservation of natural resources	246	3.41	1.17
9. Teaching about sustainable agriculture requires expert knowledge about sustainability	246	3.35	1.09
10. My students are very interested in learning about sustainable agriculture	246	3.25	1.16

Scale: 1=Strongly Disagree. 2=Disagree. 3=Neutral. 4=Agree. 5=Strongly Agree.
Key: N = Number. M = Mean. S.D. = Standard Deviation.

tended to be neutral regarding their perceptions of items 7-10. A rating of 3.50 to 4.50 was considered to be in the agree category. about 4.51 and higher in the strongly agree category. A rating of 2.51 to 3.49 was considered neutral. while a 1.00 to 1.50 was in the strongly disagree category and 1.51 to 2.50 in the disagree category.

One of the main objectives for this study was to identify the perceptions of teachers regarding teaching sustainable agriculture. In this analysis. the first item on the list was "A variety of methods could be used to teach sustainable agriculture." Respondents rated this

item highest. with mean score of 4.24 and standard deviation of .75. The second highest rated item was: "Teaching the definition of sustainable agriculture is a critical step in learning about sustainability." This item had a mean rating of 4.12. with a standard deviation of .84.

"Teaching about sustainable agriculture should add balance to the curriculum" was rated third. with a mean rating of 3.88 and a standard deviation of .78. while the fourth item stated that "Sustainable agriculture practices should be incorporated into all areas of study in agriculture." Its mean was 3.82. with a standard deviation of .90. "My students are very interested in learning about sustainable agriculture" had the lowest rating (mean = 3.25; SD = 1.16).

Based on the findings related to the first objective of the study. it can be concluded that teachers support using a variety of teaching methods for teaching sustainable agriculture. the definition of sustainable agriculture is a critical element in teaching, learning about sustainable agriculture would add balance. and it would be easy to add it to the curriculum. Overall. teachers in this study support the addition of sustainable agriculture into the curriculum. These concepts should help guide curriculum development.

When grouped by the level of education. and statistical tests were conducted to assess mean differences in perceptions. there was no significant statistical differences detected. When the same ten items were tested using "In-service training." "Teaching sustainable agriculture is an important part of my curriculum" showed a significant statistical difference as shown in Table 4 (see Appendix F for complete data). When another test was conducted using "where they teachers grew up." "Sustainable agriculture is an important part of my

Table 4. Means, standard deviations, and t-test values regarding significant differences in teachers perceptions when grouped by inservice training.

Perception Statements	No inservice n=165 Mean S.D	inservice n=81 Mean S.D	t-ratio	t-prob.
#7 Teaching sustainable agriculture is an important part of my curriculum.	3.31 1.23	3.65 1.06	4.82	.029*

Level of statistical significance: *p< .05 **p<.01. Equal variance not assumed.
Scale: 1=Strongly Disagree, 2=Disagree, 3=Neutral, 4=Agree, 5=Strongly Agree.

curriculum" equally showed a significant statistical difference as shown in Table 5 (see Appendix F).

Table 5. Means, standard deviations, and F-values regarding significant differences in teachers perceptions when grouped by where they (teachers) were raised.

Perception Statements	On-farm n=215 Mean S.D	Rural non-farm n=19 Mean S.D	Urban n=10 Mean S.D	F-ratio	F-prob.
#7 Teaching sustainable agriculture is an important part of my curriculum.	3.50 1.18	2.79 1.13	3.10 1.19	3.61	.028*

Level of statistical significance: *p< .05 **p<.01. Equal variance not assumed.
Scale: 1=Strongly Disagree, 2=Disagree, 3=Neutral, 4=Agree, 5=Strongly Agree.

These findings agree with the findings by Williams (1997) in his study of Iowa secondary school agricultural education teachers and students. According to the study, teachers had a highly favorable perception of sustainable agriculture in the secondary school agricultural education curriculum, and would like to include the teaching of sustainable agriculture in their curricula. Using the Shaffe test, those teachers growing up on the farm had higher mean score of 3.50 than rural non-farm (2.79) teachers.

When other tests were conducted based on gender. age. and years of teaching. they did not show any significant statistical differences among the variables. These findings indicate that none of the above-mentioned variables had more influence than the others regarding teaching sustainable agriculture in the high school agriculture curriculum as indicated by the teachers. Teachers seem to agree regardless of their demographic differences.

Skills and Knowledge in Sustainable Agriculture

Section B of the questionnaire asked teachers the extent to which selected skills and knowledge topics were being taught in the curriculum. Fifteen items were rated using a five-point Likert-type scale. with 1=None. 2=Low. 3=Moderate. 4=High. and 5=Very High. The means and standard deviations are reported in Table 6. Agricultural education teachers indicated that to a varying degree. they teach the selected skills and knowledge in sustainable agriculture in their curriculum.

Based on their ratings. "soil erosion control" had the highest mean of 4.06. and "soil testing" was rated second highest with a mean of 3.89. The third highest was "soil conservation" with a mean of 3.87. and "management of soil fertility" with a mean of 3.75. These four high rated skills and knowledge in sustainable agriculture have the lowest standard deviation of .98. .99. .99. and 96. respectively. "Monocropping" has the lowest mean score of 2.54. with standard highest deviation of 1.18.

When a test was conducted using gender to determine if any significant statistical differences existed among the fifteen variables. significant statistical differences between males and females were detected for "mixed cropping." and "green manure." as shown in Table 7 (see Appendix F). Male teachers appear to be teaching more about these topics.

When another test was conducted using "where they (teachers) grew up," there was significant statistical difference in the skill and knowledge area of "soil erosion control" Teachers with farm experience tend to teach more about "soil erosion control".

Table 6. Means and standard deviations of the extent to which selected skills and knowledge bases in sustainable agriculture were being taught by teachers of agriculture in selected states.

Skills & Knowledge in Sustainable Agriculture	N	M	S.D.
1. Soil erosion control	246	4.06	.98
2. Soil testing	246	3.89	.99
3. Soil conservation	246	3.87	.99
4. Management of soil fertility	246	3.75	.96
5. Water management	246	3.55	1.03
6. Integrated pest management	246	3.49	1.11
7. Crop rotation	246	3.35	1.12
8. Waste management	246	3.16	1.12
9. Reduced use of chemicals	246	3.13	1.10
10. Risk management	246	3.04	1.10
11. Mixed cropping	246	3.00	1.18
12. Mixed farming	246	2.99	1.10
13. Reduced use of fertilizer	246	2.98	1.14
14. Green manure	246	2.66	1.13
15. Monocropping	246	2.54	1.18

Scale for skills & knowledge in sustainable agriculture: 1=None. 2=Low. 3=Moderate. 4=High. 5=Very High. Key: N = Number. M = Mean. S.D. = Standard Deviation

Table 7. Means. standard deviations. and t-test values regarding significant differences in teachers skills and knowledge when grouped by gender (n=246).

Skills & Knowledge Statements	Males n=199 Mean S.D	Females n=47 Mean S.D	t-ratio	t-prob.
#5 Mixed cropping	3.09 1.12	2.62 1.26	2.365	.021*
#13 Green manure	2.78 1.09	2.15 1.21	3.502	.001**

Level of statistical significance: *p< .05 **p<.01
Scale: 1=None. 2=Low. 3=Moderate. 4=High. 5=Very High.

Table 8. Means. standard deviations. and F-values regarding significant differences in skills and knowledge when grouped by where (teachers) grew up (n=246).

Skills & Knowledge Statements	Farm n=215 Mean S.D	Rural non farm n=19 Mean S.D	Urban n=10 Mean S.D	F-ratio	F-prob.
Soil erosion control	4.12 0.94	3.95 0.78	3.00 1.49	6.627	.002**

Level of statistical significance: **p< .05 ***p<.01
Scale: 1=None. 2=Low. 3=Moderate. 4=High. 5=Very High.

Inservice training

The third section of the questionnaire asked teachers to indicate the extent to which they needed inservice education in selected topic areas related to sustainable agriculture. A five-point Likert-type scale was used to rate the items with 1=No training needed. 2=Very little training needed. 3=Some training needed. 4=Moderate amount of training needed. and 5=Much training needed. The overall ratings indicated that teachers' responses fell between "Some training needed" and "Moderate amount of training needed."

Table 9 indicates that out of the ten items. the respondents rated "Insect resistant crops" highest with a mean rating of 3.79. with standard deviation of .96. "Herbicide resistant crops" had a rating of 3.77 and a standard deviation of .96. Other high ratings included "Environmental protection" and "farm profitability."

Generally. these agricultural education teachers indicated that more training was needed on these topics. When a F-test was conducted using age as a variable. statistically significant differences were detected in the areas of "soil types and management." "Crop productivity.

Table 9. Mean and standard deviations regarding the extent to which inservice training is needed about selected sustainable agriculture practices (n=246).

Extent of Inservice Training	N	M	S.D.
1 Insect resistant crops	246	3.79	.96
2 Herbicide resistant crops	246	3.77	.96
3 Environmental protection	246	3.73	.99
4 Farming profitability	246	3.72	1.01
5 Rural culture & preservation	246	3.38	.98
6 Soil types and management	246	3.37	1.06
7 Soil structure	246	3.29	1.13
8 Crop productivity	246	3.24	.99
9 Climatic factors	246	3.23	.94
10 Tillage techniques	246	3.17	1.01

Scale: 1=No training needed. 2=Very little training needed. 3=Some training needed. 4=Moderate amount of training needed. 5=Much training needed. *p<.05. **p<.01.

and "Climatic factors" as shown in Table 10 (see Appendix F). Older teachers have more experience with teaching soil types and management. and crop productivity and the effects of climate on farming.

Table 10. One-way analysis of variance tests for age differences in selected inservice training about sustainable agriculture among secondary school teachers of agriculture (n=246).

In-service Training Statements	1 n=21 Mean S.D	2 n=67 Mean S.D	3 n=86 Mean S.D	4 n=63 Mean S.D	5 n=9 Mean S.D	F-ratio	F-prob.
#3 Soil types and management	3.90 1.14	3.22 0.98	3.22 1.10	3.44 1.12	4.00 1.12	3.052	.018*
#1 Crop productivity	3.86 0.96	3.21 0.99	3.02 0.98	3.27 0.94	4.00 0.71	4.667	.001**
#6 Climatic factors	3.71 0.90	3.12 0.91	3.12 0.91	3.21 0.99	3.91 0.78	3.160	.015*

Scale: 1=None; 2=Low; 3=Moderate; 4=High; 5=Very High.
*p<.05. **p<.01.
Key for teachers age group: 1 = 25 or less years old. 2 = 26 to 35 years old. 3 = 36 to 45 years old. 4 = 46 to 55 years old. 5 = 56 to 65 years old

When a comparison test was conducted using "years of teaching experience," there was a significant statistical difference among teachers in their need for inservice education in crop productivity.

Table11. One-way analysis of variance test of years of teaching experience for inservice training in sustainable agriculture among secondary school teachers of agriculture (n=246).

Inservice Training Statements	1 n=100 Mean S.D	2 n=94 Mean S.D	3 n=47 Mean S.D	4 n=5 Mean S.D	F-ratio	F-prob.
#1 Crop productivity	3.41 1.05	3.00 0.94	3.40 0.88	3.00 1.22	3.434	.018*

Scale: 1=Strongly Disagree. 2=Disagree. 3=Neutral. 4=Agree. 5=Strongly Agree.
Key: 1 = 10 or less years. 2 = 11 to 21 years. 3 = 22 to 31 years. 4 = 32 to 42 years

Other variables (gender. highest level of education. inservice training. and where teachers grew up showed no statistically significant differences. (see Appendix F).

Teachers' general comments

The last page of the questionnaire contained a section for open-ended comments. Out of the 246 teachers that responded to the questionnaire. 26 teachers gave comments. This information was grouped into three categories: (1) comments relating to curriculum planning in sustainable agriculture programs: (2) comments relating to content development in sustainable agriculture programs. and (3) information about inservice education training programs.

Comments relating to curriculum planning in sustainable agriculture programs

1. I think this would be a great opportunity to add information to the natural resources class that I am teaching currently. Up-to-date information is critical to this profession and to your credibility. I am very interested in your future mailings.

2. I feel "sustainability" needs to become part of an ethic which colors our perceptions and actions. Our long term survival as a species depends in part, on not depleting key resources such as air, soil and water.
3. I fully believe that agriculture must start to concentrate on the quality of the product that it markets. Research for the past 100 years has concentrated on quantity not quality. As a result, it takes a lot of processing to turn our products into something the consumer wants. I am convinced that as farmers, we must explore ways of production and marketing that takes us out of the straight commodity market if we are to survive. Would like more information on "sustainability" of farming. I generally have a problem with the philosophy of most of those preaching "sustainable" agriculture, especially as it relates to lower fertilizer and chemical use, or something being better for the environment, especially of organic farming. I am not into deceiving the public about the supposed dangers of chemical use or the supposed benefits of organic farming, but low input agriculture will hurt the environment in the long run.

Sustainable agriculture is new and curriculum planners are working hard to keep agricultural education teachers informed about current changes for curriculum update. It takes commitment and dedication to provide students with up-to-date information in order for them to stay current. Academic supervisors must confront this challenge by providing teachers with the support materials, information and incentives that they may need for professional growth. O'brien (1995) explained that the key importance of information is to enable us gain knowledge, learning and better resource allocation.

Comments relating to content development in sustainable agriculture programs

1. I include sustainable practices in all instruction. I do not teach true agriculture "farming" methods, rather more components such as nutrition, genetics, fertility, seed selection, with broad applications to yards, fields, pasture, greenhouse, etc.
2. Soil science and structure are important.
3. I teach horticulture, so many of the students would benefit from agriculture classes.
4. I believe sustainable agriculture is important for viable long-term management objectives. Additionally, it is the ethical responsibility of a land-owner, as land management affects a community and the world.
5. We have a natural resource management course that incorporates resource conservation and farm practices that are both profitable and beneficial to natural resources.
6. I have very few farm students. I teach more of a science base agriscience than production.
7. The importance of introducing sustainable agriculture to urban areas is of great concern. As a teacher in a large urban center such as Chicago, the interest is high for most of the students but progress toward achieving the resources to create an organic farm model are lacking. Progress has been made however, for the first time the Agriculture Academy at John Marshal converted the greenhouse seedling to a small vegetable site. We practiced crop management, and harvested fresh produce. The level of educational value has been tremendous. The connection of the importance of agriculture in our lives is clearer. More is needed in areas of funding and education/technical assistance especially for programs dedicated to teaching agriculture at the high school

level.

8. The topic of sustainable agriculture is difficult to understand. Maybe, people like you will help in educating us through organizing inservice training, and talking to farmers and community.
9. I teach agriculture mechanics where equipment repair operation is focused. Sustainable agriculture is no where near my main focus.
10. I teach plant and soil science, and greenhouse management. It is hard to teach sustainable agriculture in this teaching situation. I add in agricultural ideas where ever I can but it is limited. I would also need some additional training to teach this topic well.

Deciding the content to be taught about sustainable agriculture is as hard as it is for every other topic. It takes scholarship, training, and practice for agricultural education teachers to master what should be included in the curriculum and why. Teachers must draw a relationship between what to teach, what the students need, and what the community expects. Wisniewski (1986) explained that this ideal is something of a composite. It should be seen as a norm, as what an ideal agricultural education teacher should be like, though there must always be some who offer a different view (pg. 288).

Comments about inservice education and training programs

1. Your information and survey does not relate much to urban programs. Direct and mail your future survey only to those institutions whose responses will be appropriate based on their curriculum. We are urban Cleveland, OH.
2. This seems rather pointless. I am not a traditional crop teacher. Most of this does not pertain to my situation, and I have no idea how much inservice others need.

3. Our smaller and family farms need to know more about sustainable farming opportunities in order to compete and to make a living. Corporate agriculture sure will change agriculture.
4. I guess I am not familiar with the term sustainable!!. It seems like a big word that doesn't draw any attention to me!!.
5. I am not certain what the new meaning of "sustainable" agriculture is. Academia changes terminology quite often to set up "new" ideas from "old" concepts. We teach in West Central Ohio with 160 agriculture students, 3 agriculture teachers, with dairy sheep, hogs, corn, wheat, soybeans and hay being the major income. Apples and vegetable crops also add a small part of the economy. I have been attending college since 1956, last time in 1999, but sustainable agriculture has not been part of the discussion. I would like to know what it means.
6. Sustainability agriculture is a crisis. We are seeing farms leaving production agriculture. Farms are growing larger. This is a special crisis for our small communities both in terms of number of youth for our schools and services in the community.
7. I would be in favor of adding sustainable agriculture into units I currently teach. Maybe we could be provided with labs/lessons that we could attach to our current units.
8. If something is not done soon, mono-culture agriculture will be all that is left.
9. My comments depend upon what your definition of "sustainable" agriculture is. I teach how to use our resources as efficiently as possible and only use inputs that are needed. Manure, if available, is used as a resource, not as a waste. However, I do not

subscribe to what some people call "sustainable agriculture" where the emphasis is on organic farming. Some of what I have heard called "sustainable" borders on the impractical: it is not cost-effective, and it is weird.

10. Good-luck with your research

11. I teach a vocational class in floral design. This doesn't really apply to my class.

It is not unusual to find teachers who are not familiar with new concepts such as sustainable agriculture. Inservice education programs help teachers to update their knowledge. In a research progress report released by the Leopold Center for Sustainable Agriculture (1994), use of inservice education, and conferences for disseminating information on sustainable agriculture was promoted. Through such inservice education programs, teachers share information and current practices for curriculum update.

CHAPTER V. DISCUSSION

The main purpose of this study was to determine the perceptions of teachers in the North Central Region of the United States regarding selected aspects of sustainable agriculture.

The specific objectives for this study were to (1) identify perceptions of teachers regarding basic concepts of teaching sustainable agriculture. (2) identify the extent to which teachers teach selected sustainable agriculture skills and knowledge. (3) identify the extent to which inservice training is needed to be able to teach sustainable agriculture practices. skills and knowledge. (4) identify demographic characteristics and their relationship to selected perceptions. and (5) develop a model for an inservice education program for teachers of agricultural education.

This chapter is presented under the following sub-sections: (1) Perceptions regarding concepts of teaching related sustainable agriculture. (2) Skills and knowledge in sustainable agriculture; (3) Inservice training. The purpose of this chapter is to discuss the findings.

Perceptions

One of the main objectives for this study was to identify the perceptions of teachers regarding teaching sustainable agriculture. The findings from the statistical analysis indicated that teachers were in agreement with basic concepts of teaching sustainable agriculture. In a study on perceptions regarding sustainable agricultural practices. Kotile (1998) found that respondents were interested in sustainable agricultural practices. Gamon and Scofield (1998) conducted a study on perceptions of sustainable agriculture with young and potential producers and found that the respondents were interested in agricultural practices that are sustainable. Williams (1997) made a similar observation in his study about

the perceptions of Iowa secondary school agricultural education teachers regarding sustainable agriculture. He found that teachers were interested in the concept of sustainable agriculture. Therefore, if teachers are given enough incentives such as motivation, materials to work with, or inservice training, teachers can be successful. Such "tools" would enable the teachers to do what they can do best: find individual strength, encourage it and set standards for achievement (Day, 1993, pg. 3).

Knox (1986) cited in Dirkx (1997) argued that choosing and implementing effective learning activities does not come easy, because plans for how to accomplish needs, context, and objectives determine how to select the educational materials. Knox (1986) believed that content and methods of teaching must be related in order for the process to be successful. He explained that teaching and learning activities would become more meaningful if we could interpret and relate content to experiences (pg. 77-106).

In what the Kellogg Commission (1999) described as "The Engaged Institution," heads of schools were reminded that new knowledge is one distinctive thing schools can provide. The Commission believed that education and economy requires attention, and said agriculture and food issues need to be emphasized. The Commission challenged institutions to do more for the sake of service to community. With the resources and qualified professors and staff in our schools, the Commission felt that we can organize our institutions to serve both local and national needs in a more coherent and effective way to provide more access to knowledge and information (pg. 1-20).

Some agricultural education teachers offering comments on the questionnaire indicated that they included sustainable agricultural practices in their instruction. Most of them indicated they gained their experiences about sustainable agriculture through a variety of

ways. However. some teachers admitted that they were struggling with the definition of sustainable agriculture.

Agricultural education is a community-based program and the members of the community are expected to be knowledgeable about issues for the achievement of common goals through collective action (Agbaje. 1998). The educational needs of the community may transcend the selected variables of gender. age. educational level. and where teachers were raised.

Rawson (2001) explained that concerns about the adverse environmental and public health effects of using synthetically compounded fertilizers. pesticides. fungicides. and herbicides in farming forced programs on sustainable agriculture to proliferate (pg. 1-2). Cantrall et.al (2000) acknowledged that the concept of sustainable agriculture is political. and added that President Clinton himself was an advocate for sustainable agriculture. According to Cantrall et.al. keeping farms small and family-run is one of the main goals of sustainable agriculture (pg. 2-3). Lasley et al (1993) explained that sustainable agriculture offers alternative practices and values intended to promote environmental stewardship. conserve resources. preserve farm traditions. and support rural communities (pg. 133).

In a Congressional research service report about sustainable agriculture. Rawson (2001) said sustainable agriculture is used to designate both a reduced-chemical approach to farming and an alternative political viewpoint on the distribution of economic and social benefits in the farm sector. Rawson explained that sustainable agriculture is characterized by the substitution of farm resource management involving more labor for purchased inputs of fertilizers and pesticides (pg. 1).

Rawson said sustainable agriculture comprises a range of practices that include integrated pest management. crop rotations for pest. disease. and erosion control. and alternative tillage

and planting practices to reduce soil erosion (pg. 1). Opponents argue that widespread adoption of sustainable agriculture practices would lead to lower farm income and decreased productivity, raise domestic food prices, force more marginal acres into production (to the detriment of wildlife and environment), and require a return to smaller and more labor-intensive farm units (pg. 1).

Skills and knowledge in sustainable agriculture

The second objective for this study was to identify the extent to which high school agricultural education teachers teach selected skills and knowledge in sustainable agriculture. The analysis showed that every teacher who responded to the questionnaire believed that he or she taught the selected skills and knowledge to some extent. However, emphasis was put on certain items such as "mixed cropping," "use of green manure," and "soil erosion control." "soil testing," "soil conservation," and "management of soil fertility" have high mean rates of 3.87, 3.75, and 3.89, respectively, while "Reduced use of chemicals" and "Reduced use of fertilizers" have high standard deviations of 1.14, and 1.10, respectively.

These findings support Hunter's (1995) statement that of all school factors that promote students' successful learning, the professional skills and knowledge of teachers are the most powerful. Hunter said teaching skills are more important than books, equipment, and materials. She affirmed that enhancing teachers' skills has potential usefulness in the preparation and development of teachers (pg. 208-210).

In their research findings on Farmer Perceptions of Soil and Water Conservation Issues, Martin & Bruening (1992) found that there is need for improved education related to the management of agricultural chemicals and their use. Martin & Bruening (1992) found that

pesticides are used by farmers on over 90 percent of the corn and soybean fields in Midwest (pg. 1-4).

Inservice education

The third objective for this study was to identify the extent to which inservice training was needed in selected areas of sustainable agriculture. In this section, teachers were requested to indicate the inservice training that they feel they needed in selected areas of sustainable agriculture. The analysis for this study indicated that agricultural education teachers believed that some amount of training was needed in all the identified areas of sustainable agriculture. This is in line with the report by Williams (1997) that teachers felt they had additional things to learn (pg. 15).

The Congressional Research Service (2001, pg. 1-6) reported that there are state and local research and demonstration programs on sustainable agriculture throughout the U.S. Several states, such as Iowa, California, and Minnesota, for example, have mandated state-supported agricultural research on sustainable practices. These states encourage the concept of sustainable agriculture through programs of their state departments of agriculture. At the national level, the Federal Government for a number of years has supported certain concepts of sustainable agriculture as part of soil and water conservation research and implementation programs, such as the Integrated Pest Management (IPM) program, which began in 1972.

Tessmer et. al (1999) believed that an inservice education program is vital to any profession. According to Tessmer et al (1999) the rapid acceleration of change in our modern institutions makes inservice education a more significant and challenging problem. Tessmer et.al (1999) argued that if teachers have information and training programs at local, state, and federal levels and still lack adequate information about sustainable agriculture, an

evaluation of the existing training about sustainable agriculture should be conducted to reassess and determine what training needs still exist. Tessmer et.al (1999) suggested that such a process would help curriculum designers to identify both instructional and non-instructional interventions to upgrade existing instructional programs (pg. 86-96).

Yeatts (1976) stated that every teacher owes some of his or her time to the advancement of his profession. According to Yeatts, few teachers would argue the theoretical correctness of Theodore Roosevelt's statement that the advancement of the teaching profession, collectively called inservice education, has received plenty of lip service, but too often been the stepchild of operating budgets. Yeatts argued that competency and independence are the purpose of teacher inservice education training. He believed that inservice education programs offer sustained support to teachers by providing them with opportunities to learn how to teach better (pg. 417).

Tessmer et al (1999) explained that inservice training programs usually are based on a deficiency model that may reassess an existing training program to determine what training needs still exist, or excess-based model designed to identify instructional excesses as well as deficiencies (pg. 86).

In designing the teacher-centered inservice education training model for this study as shown in Figure 9, inspiration was gained from Weber's (1996, pg. 1-20) approach to inservice that used the living soil to create a teacher-centered inservice educational package for cross-disciplinary teaching and curriculum development. His purpose focused on environmental stewardship to enrich teacher-existing curriculum in cross-disciplinary learning in the subject matters of earth science, environmental sciences, agriculture, biology, language, arts, speech, history, conservation, and natural resources.

Weber (1996) used the earthworm as a bridge between agriculture and non-traditional agricultural subjects, linking agriculture concepts to social studies, history, science, mathematics, language, and the arts. Weber (1996) acknowledged our future that depends on our younger generations having sufficient knowledge to make decisions, and believe that his package would help high school students to discover the value of an environmentally sound agriculture and the relationship to our natural resources through experiential learning, FFA, 4-H, and students preparing for soil judging.

Knowles (1970) stated that "agricultural practices seem to be suffering from deplorable cultural lag because of the elaborate technology it has established for continuous long-run direction program review". Knowles gave an example with a county agricultural extension service, that continued to focus on helping farmers improve their efficiency in growing crops, as provided in its statement of purpose, long after almost all of the land of the county had become occupied by suburban homes (pg. 125). Knowles argued that the objective for establishing all agricultural extension practices is to accomplish the institutional mission, and protect the social and institutional goals it is authorized to serve.

Knowles believed that the tendency is for users to regard the existing agricultural extension service as being more or less permanent and to resist changes. He felt that it is urgent, especially in this era of accelerating social change, that an institution's general purposes as regards teaching and learning be tested continuously against changing needs as an integral part of the ongoing program-development process, to provide concrete guidelines for program development and decision-making as to what particular activities would be scheduled for what groups of participants. This has relevance to teachers of agriculture

because the curriculum is continually experiencing pressure for change. Teachers need to be helped with this change through inservice education (pg. 125-127).

The inservice education model presented here indicates how agricultural education teachers can use it to develop high school agricultural education curriculum for the purpose of integrating the needs of the community, institutions, and individuals. The model would helps explain how agricultural education teachers learn and master basic skills and knowledge on a broad spectrum that enables them to infuse new knowledge, for example, in sustainable agricultural perspectives, into agriculture courses. The strategies could include personalizing information through various learning activities, case studies, literary analysis, and cooperative learning (MacPhee, 1994). By so doing, we would be developing staff programs around teaching approaches with known potentials for increasing student learning (Joyce et al. 1987).

The model presented in Figure 9 describes how the teacher of agriculture is dependent on the "three corners" of his/her professional life: input from an advisory committee, continuous inservice education on technical agriculture, and teaching-learning skills and professional development through formal education. These three areas of concern need to be in balance to have a successful program in agricultural education.

Sustainability has its cornerstone in the concept of "balance." If the teacher of agriculture practices the balance then the students will see it. Additional topics like sustainable agriculture will find their way into the curriculum because input from the three areas of concern will guarantee exposure to new and challenging ideas.

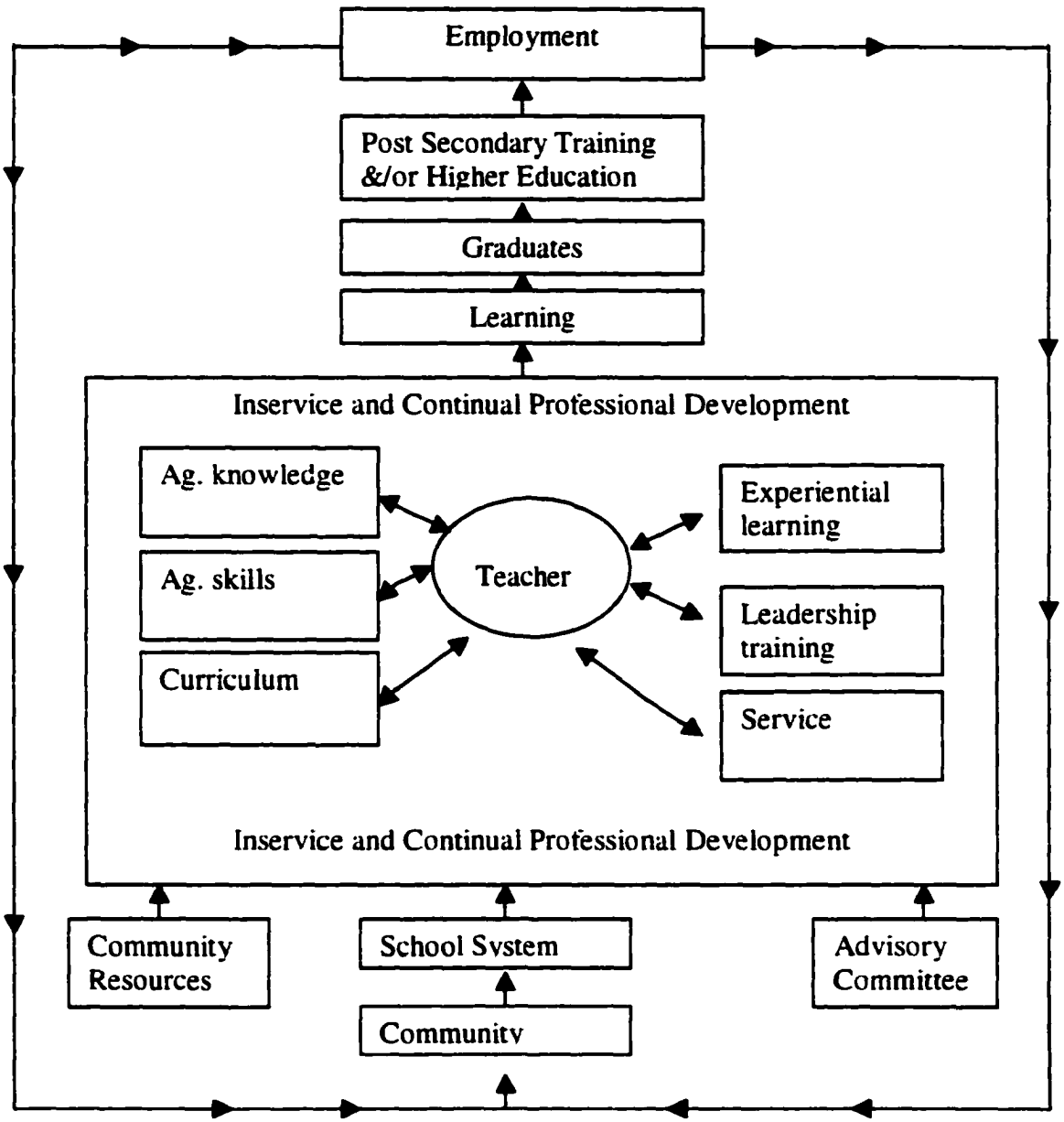

Figure 9. A Teacher-Centered Inservice Education Model in Agriculture

The model focuses on the teacher as the agent for change, and the design assumes that through inservice education programs, the teacher would gain skills and knowledge that he/she would need to develop high school agricultural education programs that would help meet the needs of the community, institutions, and individuals.

For example, if farmers need to learn the techniques for successful management of weeds in ridge-till cultivation, using mechanical and cultural controls, institutions can meet the operational needs by opening sustainable communication with the community through students, experts, extension, or faculty who would demonstrate how to use cover crops or litter to control weeds.

CHAPTER VI. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The purpose of this chapter is to provide a summary of the study including a focus on the main findings, conclusions and recommendations. This chapter is presented as follows: (1) summary, (2) conclusions, (3) recommendations, and (4) implications to agricultural education.

The main purpose of this study was to determine the perceptions of teachers in the North Central Region of the United States regarding teaching sustainable agriculture. This region is comprised of the states of Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin.

The specific objectives for this study were to: (1) identify perceptions of teachers regarding basic concepts of teaching sustainable agriculture, (2) identify the extent to which selected sustainable agriculture skills and knowledge were taught by teachers of agriculture, (3) identify the extent to which inservice training is needed in selected areas of sustainable agriculture, (4) identify demographic characteristics and their relationship with selected perceptions, and (5) develop a model inservice education program for teachers of agricultural education.

Procedure

The study utilized a descriptive research design. A researcher developed questionnaire was used to collect data. The mail-back questionnaire was adopted in order to reduce cost, save time, and to reach unknown individuals within a short space of time. The population for this study consisted of all secondary school agriculture teachers in the twelve states of the North Central Region of the United States. The defined population was a total of 2395

teachers as listed in the Agricultural Educator's Directory, 2000, but a randomly selected sample of 600 was used, with a usable return rate of 246.

The usable data were analyzed using the Statistical Package for Social Sciences (SPSS) Program, and the independent sample t-test. The alpha level was set at .05, and a One Way Analysis of Variance (ANOVA) was used to test for any significant differences that might exist in the perceptions of teachers based on selected variables.

Major Findings

1. Out of the 246 respondents, 199 (81%) were males, while 47 (19%) were females.
2. All the teachers had varied teaching experiences and some had attended inservice education training on sustainable agriculture.
3. Some of the teachers were raised on the farm, and they tended to be more positive about sustainable agriculture practices.
4. There were no statistically significant differences among the respondents when perception statements were compared by gender, age, years of teaching, and farming experience.
5. Using a variety of methods was perceived to be very important to teach sustainable agriculture
6. The definition of sustainable agriculture is a critical issue when teaching about sustainability.
7. Teachers perceived that teaching about sustainable agriculture would add balance to the curriculum.

8. Differences in age, years of teaching experience, inservice education, level of education, and farming experience were generally not statistically significant as rated to the extent teachers taught selected knowledge and skills in sustainable agriculture.
9. Teachers indicated that they taught the following skills and knowledge to a great extent: "soil erosion control", "soil testing", and "soil conservation".
10. Differences in gender, level of education, inservice training, where teachers were raised, and farming experience, were generally not statistically significant regarding the need for inservice education training.
11. Teachers indicated a great need for inservice education in the following areas: "insect resistant crops", "herbicide resistant crops", and environmental protection".

Conclusions

Based on the findings from this study, the following conclusions were made:

1. Agricultural education teachers supported basic concepts regarding teaching sustainable agriculture.
2. Agricultural education teachers believe that sustainable agriculture needs a clearer definition.
3. Agricultural education teachers agreed that a variety of methods could be used to teach students various sustainable agriculture skills and knowledge.
4. Agricultural education teachers supported infusion of selected sustainable agriculture practices in the study of agriculture.
5. Agricultural education teachers indicated that they needed more information regarding sustainable agriculture.
6. Agricultural education teachers indicated they need more instructional materials in order

to teach sustainable agriculture skills and knowledge.

7. Agricultural education teachers indicated a need for inservice education programs focused on sustainable agriculture to be able to adequately teach the selected skills and knowledge.
8. Agricultural education teachers indicated that soil erosion control, soil testing, and soil conservation practices were being taught to a greater extent than all other topics in sustainable agriculture.
9. Agriculture education teachers identified insect resistant crops, herbicide resistant crops and environmental protection as priority areas for inservice education programs.

Recommendations

Though sustainable agriculture has many definitions, it could be defined as a system of agricultural practices that could be used to educate the public about production techniques that encourages use of rotational systems, processes, and learning to improve our experiences about the food and fiber industry. Infusing sustainable agriculture practices in the high school curriculum is important because it would increase learning and use of broad technologies, systems, and practices for the purpose of balancing the ecosystem.

Based on the review of literature, the findings, comments by teachers, and the conclusions of this study, the following recommendations were made:

1. Technical agriculturists and educators need to develop a clearer definition of sustainable agriculture.
2. Teacher educators and state supervisors of agricultural education should develop a systematic and sustainable inservice program for teachers to upgrade their skills and knowledge in selected topics supporting sustainable agriculture.

3. Agricultural Education departments at all levels (secondary. community college and university) should emphasize education programs on sustainable agriculture.

Suggestions for Future Research

1. Further studies are needed regarding the best methods and tools to use in teaching sustainable agriculture.
2. Further studies need to be conducted to investigate and develop appropriate inservice education programs focused on sustainable agriculture.

Implications and Educational Significance

This study examined teacher perceptions regarding the teaching of sustainable agriculture in agricultural education secondary schools in the North Central Region of the United States. There are three implications from this study that make the findings important to the body of knowledge in agricultural education. There is a considerable amount of confusion about sustainable agriculture. However. when asked to respond to specific questions about various practices. teachers indicate their use of these practices.

There seems to be a gap between what is being taught and what is generally thought to be concepts of sustainability. The study confirms the findings of other studies that a need exists for more appropriate teaching materials and training in sustainable agriculture. This implies that a significant educational program in sustainable agriculture is necessary.

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APPENDIX A: HUMAN SUBJECTS APPROVAL FORM

Iowa State University Human Subjects Review Form

OFFICE USE ONLY
EXPEDITED X FULL COMMITTEE ___ ID# 01-591

PI Last Name OKEAFOR **Title of Project** Teacher Perceptions Regarding the Role of Sustainable Agriculture in the Agricultural Education Curriculum

Checklist for Attachments

The following are attached (please check):

13. ☒ Letter or written statement to subjects indicating clearly:
    a) the purpose of the research
    b) the use of any identifier codes (names, #'s), how they will be used, and when they will be removed (see item 18)
    c) an estimate of time needed for participation in the research
    d) if applicable, the location of the research activity
    e) how you will ensure confidentiality
    f) in a longitudinal study, when and how you will contact subjects later
    g) that participation is voluntary; nonparticipation will not affect evaluations of the subject
14. ☐ A copy of the consent form (if applicable)
15. ☐ Letter of approval for research from cooperating organizations or institutions (if applicable)
16. ☒ Data-gathering instruments

17. Anticipated dates for contact with subjects:

First contact	**Last contact**
JUNE 1, 2001	JULY 1, 2001
Month/Day/Year	Month/Day/Year

18. If applicable: anticipated date that identifiers will be removed from completed survey instruments and/or audio or visual tapes will be erased:

    OCTOBER 31, 2001
    Month/Day/Year

19. Signature of Departmental Executive Officer [signature] Date 5/30/01 Department or Administrative Unit Ag. Education & Studies

20. Initial action by the Institutional Review Board (IRB):

    ☒ Project approved ☐ Pending Further Review _____ Date ☐ Project not approved _____ Date

    ☐ No action required _____ Date

21. Follow-up action by the IRB:

    Project approved ☐ Project not approved _____ Date Project not resubmitted _____ Date

Patricia M. Keith 6-7-01 PMKeith
Name of IRB Chairperson Approval Date Signature of IRB Chairperson

APPENDIX B: LETTER TO HUMAN SUBJECTS

Department of Agricultural Education & Studies
223 Curtiss Hall
Iowa State University
Ames. IA 50011
May 16. 2001

The Office of Human Subjects
15 Pearson Hall
Iowa State University
Ames. IA

Dear Human Subject.

The purpose of this study is to identify the perceptions of high school teachers of agriculture regarding sustainable agriculture practices and the extent to which there is need for in-service training and professional development in this area of the curriculum in the North Central Region of the United States. This region comprised of Illinois. Indiana. Iowa. Kansas. Michigan. Minnesota. Missouri. Nebraska. North Dakota. Ohio. South Dakota. and Wisconsin.

My specific objectives for this study include: (1) to identify perceptions of teachers regarding teaching basic sustainable agriculture concepts; (2) to identify the importance of selected sustainable agriculture skills and knowledge; (3) to identify the extent to which in-service training is required to be able to teach sustainable agriculture practices. skills and knowledge. and (4) to identify demographic characteristics and their relationship with selected perceptions.

This is a descriptive census study of all the teachers of high school agriculture education in the North Central Region of the United States. The nature of the data to be gathered will be use of questionnaire. The principal investigator hopes to attach a cover letter when sending out this instrument. Later. he plans to use card and letter of reminder as incentive and follow-up technique in effort to appeal to those participants who may have forgotten to complete and return their instrument on time.

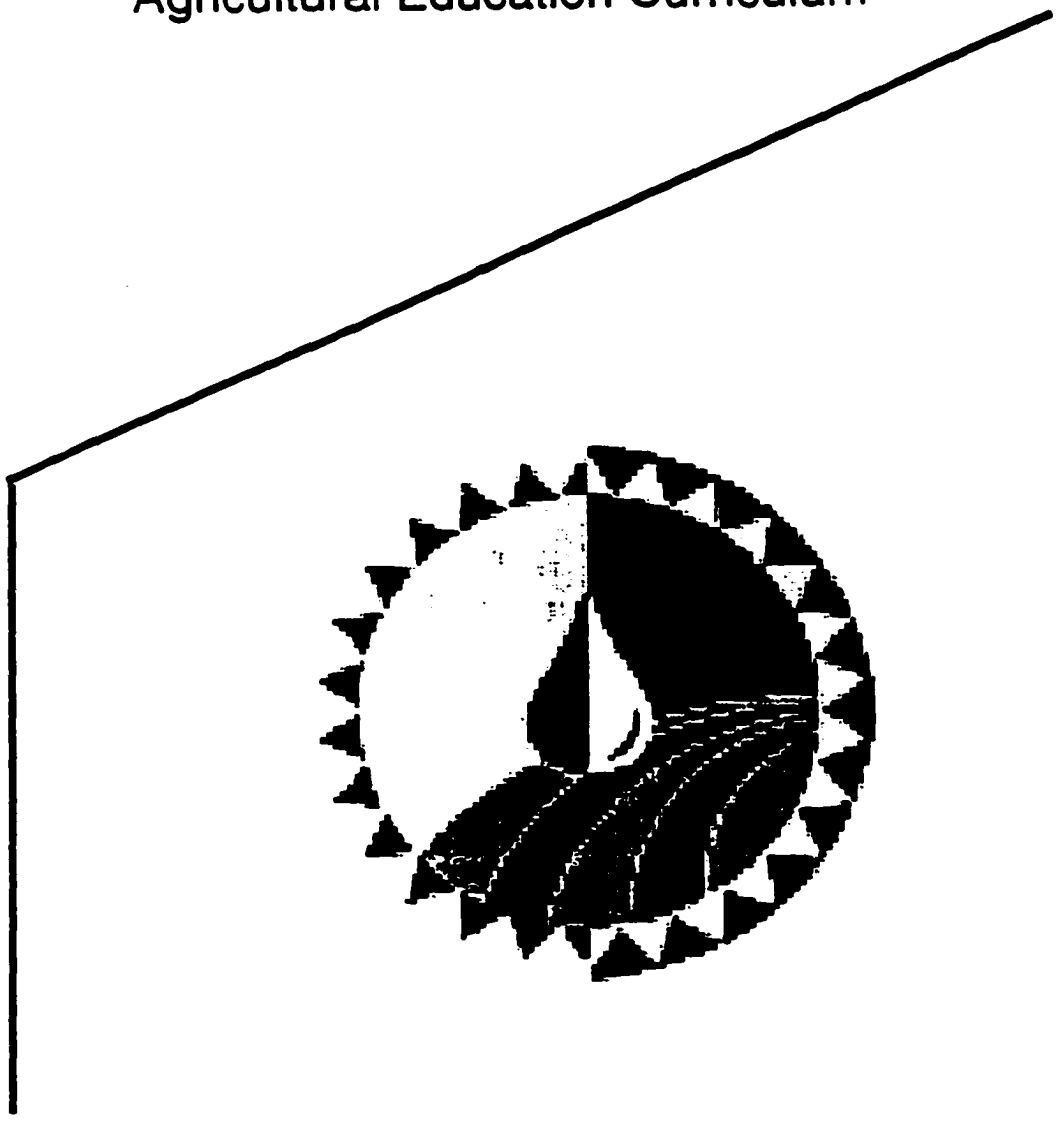
Sincerely.

Emmanuel C. Okeafor
(Researcher)

Dr. Robert A. Martin
(Head & Major Advisor)
Department of Agricultural Education and Studies
201 Curtiss Hall
Ames. Iowa 50011-1050

APPENDIX C: INSTRUMENT FOR DATA COLLECTION

Teacher Perceptions Regarding the Role of Sustainable Agriculture in the Agricultural Education Curriculum



Sustainable agriculture integrates approaches and practices of agricultural systems that are ecologically sound, environmentally humane, economically viable, and socially responsible. (Ikerd, 1996)

Thank you for your time in completing this questionnaire. Please return the completed survey in the enclosed self-addressed, stamped envelop to:

Emmanuel C. Okeafor
Dept. of Ag Education & Studies
Iowa State University
201 Curtiss Hall
Ames, Iowa 50011

Questionnaire

Section A: Perceptions Regarding Teaching Basic Sustainable Agriculture Concepts

Directions: Please indicate your level of agreement by circling the number that reflects your perceptions regarding teaching sustainable agriculture concepts to agricultural secondary school students. Use the following scale:

1=Strongly Disagree; 2=Disagree; 3=Neutral; 4=Agree; 5=Strongly Agree

Teaching Basic Sustainable Agriculture Concepts

1.	Teaching about sustainable agriculture practices would add balance to the curriculum.	1	2	3	4	5
2.	Sustainable agriculture practices should be incorporated into all areas of study in agriculture.	1	2	3	4	5
3.	It would be easy to infuse sustainable agriculture into the curriculum.	1	2	3	4	5
4.	Sustainable agriculture should be taught as a unit of instruction.	1	2	3	4	5
5.	Teaching about sustainable agriculture requires expert knowledge about sustainability.	1	2	3	4	5
6.	Teaching sustainable agriculture is the same as teaching conservation of natural resources.	1	2	3	4	5
7.	Teaching sustainable agriculture is an important part of my curriculum.	1	2	3	4	5
8.	My students are very interested in learning about sustainable agriculture.	1	2	3	4	5
9.	Teaching the definition of sustainable agriculture is a critical step in learning about sustainability.	1	2	3	4	5
10.	A variety of methods could be used to teach sustainable agriculture.	1	2	3	4	5

Section B: Skills and Knowledge in Sustainable Agriculture

Directions: The items in this section represent selected sustainable farming practices that are used by some farmers. Please indicate the extent to which you teach these skills and knowledge topic areas in your curriculum.

1=None; 2=Low; 3=Moderate; 4=High; 5=Very High

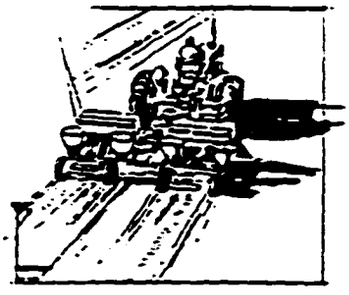
SKILLS & KNOWLEDGE		Extent Taught				
1.	Soil conservation	1	2	3	4	5
2.	Risk management	1	2	3	4	5
3.	Crop rotation	1	2	3	4	5
4.	Mixed farming	1	2	3	4	5
5.	Mixed cropping	1	2	3	4	5
6.	Mono-cropping	1	2	3	4	5
7.	Integrated pest management	1	2	3	4	5
8.	Reduced use of chemicals	1	2	3	4	5
9.	Reduced use of fertilizers	1	2	3	4	5
10.	Waste management	1	2	3	4	5
11.	Water management	1	2	3	4	5
12.	Management of soil fertility	1	2	3	4	5
13.	Green manure	1	2	3	4	5
14.	Soil testing	1	2	3	4	5
15.	Soil ersion control	1	2	3	4	5

Section C: Extent to which inservice training is needed about Sustainable Agriculture

Directions: Please circle the number that best indicates the inservice training teachers need in selected area of sustainable agriculture.

1=No training needed
2=Very little training needed
3=Some training needed
4=Moderate amount of training needed
5=Much training needed

SELECTED TRAINING TOPIC AREAS		Level of Training Needed				
1.	Crop productivity	1	2	3	4	5
2.	Environmental protection	1	2	3	4	5
3.	Soil types and management	1	2	3	4	5
4.	Tillage techniques	1	2	3	4	5
5.	Rural culture & preservation	1	2	3	4	5
6.	Climate factors	1	2	3	4	5
7.	Farming profitability	1	2	3	4	5
8.	Herbicide resistant crops	1	2	3	4	5
9.	Insect resistant crops	1	2	3	4	5
10.	Soil structure	1	2	3	4	5



Section D: Demographic Information:

Directions: Please complete each item as appropriate..

1. What is your gender?

   _____ Male _____ Female

2. What is your age?

   _____ Years

3. How many years have you taught agriculture in your present position?

   _____ Years

4. How many years have you been teaching?

   _____ Years

5. Have you ever attended an in-service education program focused on sustainable agriculture practices?

   _____ Yes _____ No

6. What is your highest level of education?

   1. ___ Bachelor's Degree 2. ___ Master's Degree

   3. ___ Ed. D. Degree 4. ___ Ph.D. Degree

7. Where did you grow up?

   _____ on the farm _____ in an urban area

   _____ rural non-farm

8. What farming experiences do you have?

   _____

   _____

   _____

General Comments:

Code _____

Appendix D: COVER LETTER TO PARTICIPANTS

IOWA STATE UNIVERSITY
Of SCIENCE AND TECHNOLOGY

Department of Agricultural Education &
201 Curtiss Hall
Ames, Iowa 50011-1050

August 24, 2001

Dear Teacher of Agriculture,

Sustainable agriculture is both a philosophy and a system of farming that has roots in a set of values that reflect an awareness of both ecological and social realities. Many farmers have expressed their feelings about sustainable agriculture. However, it is of great importance that teachers of agricultural subjects give their input regarding various elements of the sustainable agriculture movement.

To this end, we need your help. Would you please complete the enclosed brief questionnaire? It should take less than 15 minutes to complete. The purpose of this study is to identify the perceptions of high school teachers of agriculture regarding sustainable agriculture practices and the extent to which there is need for in-service training and professional development in this area of the agriculture curriculum.

There is no risk involved in completing this questionnaire. Participation is voluntary and nonparticipation will not affect you in any way. Should you choose to participate, your name will not be used anywhere, and the data collected from your responses will be strictly for academic purposes. We are interested in group data only. Identifier code numbers have been assigned to indicate return of questionnaires. All code numbers and instruments will be destroyed once the data is recorded. The data from this survey will be used to complete a Ph.D. program in Agricultural Education. In addition, the data will be very helpful in development of instructional materials to be used by teachers.

Please return the questionnaire by September 28, 2001, and if you cannot participate, send back the survey form. We appreciate your cooperation in this important study.

Sincerely,

Emmanuel C. Okeafor
Graduate Research Assistant

Dr. Robert A. Martin
Professor & Head

APPENDIX E: LETTER OF REMINDER TO PARTICIPANTS

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

September 26, 2001

Dear Teacher of Agriculture,

Some weeks ago, we mailed you a questionnaire on Teacher Perceptions Regarding the Role of Sustainable Agriculture in the Agricultural Education Curriculum. Up till now, we have not heard from you.

We understand that this period of the year is very busy in the school system. However, we still need your help. Please, take a few minutes in completing and returning the questionnaire in the stamped-addressed envelope that we mailed to you. The information we need from you is for the completion of a Ph.D. degree, and the confidentiality of your responses is ensured.

If you have already completed and mailed back the questionnaire, please disregard this letter and thank you. You can choose not to participate in this study. If you decide to do so, please return the questionnaire to us.

Should you have any questions, please call us at (515) 294-0896. We would highly appreciate your participation in this study.

Thanks for your cooperation.

Sincerely,

Emmanuel C. Okeafor
Research Assistant

Dr. Robert A. Martin
Professor & Head, Agricultural Education

APPENDIX F

t-tests for gender differences in perceptions regarding teaching basic sustainable agriculture concepts among secondary school teachers of agriculture n=246.

Perception Statements	Male n=199 Mean S.D	Female n=47 Mean S.D	t-ratio	t-prob.
A variety of methods could be used to teach sustainable agriculture	4.26 0.73	4.19 0.85	.529	.597
Teaching the definition of sustainable agriculture is a critical step in learning about sustainability.	4.14 0.83	4.02 0.90	.874	.383
Teaching about sustainable agriculture would add balance to the curriculum.	3.92 0.72	3.72 0.97	1.303	.198
Sustainable agriculture practices should be incorporated into all areas of study in agriculture.	3.83 0.89	3.77 0.94	.467	.641
It would be easy to infuse sustainable agriculture into the curriculum.	3.79 0.92	3.66 0.98	.856	.393
Sustainable agriculture should be taught as a unit of instruction.	3.52 1.03	3.40 1.08	.673	.502
Teaching sustainable agriculture is an important part of my curriculum.	3.47 1.18	3.23 1.22	1.212	.227
Teaching sustainable agriculture is the same as teaching conservation of natural resources.	3.38 1.19	3.53 1.12	-.787	.432
Teaching about sustainable agriculture requires expert knowledge about sustainability.	3.29 1.09	3.60 1.04	-1.732	.085
My students are very interested in learning about sustainable agriculture.	3.26 1.14	3.21 1.25	.231	.818

Scale: 1=Strongly Disagree. 2=Disagree. 3=Neutral. 4=Agree. 5=Strongly Agree.

Table 5. Independent two way-sample t-tests for age differences in perceptions regarding teaching basic sustainable agriculture concepts among secondary school teachers of agriculture n=246.

Perception Statements	1 n=21 Mean S.D	2 n=67 Mean S.D	3 n=86 Mean S.D	4 n=63 Mean S.D	5 n=9 Mean S.D	t-ratio	t-prob.
A variety of methods could be used to teach sustainable agriculture	4.24 0.94	4.27 0.75	4.24 0.75	4.29 071	3.78 0.67	.925	.450
Teaching the definition of sustainable agriculture is a critical step in learning about sustainability.	4.00 1.95	4.16 0.73	4.09 0.88	4.16 0.85	4.00 0.71	.251	.909
Teaching about sustainable agriculture practices would add balance to the curriculum.	3.90 0.944	3.85 0.78	3.81 0.73	3.98 0.73	4.00 1.12	.518	.723
Sustainable agriculture practices should be incorporated into all areas of study in agriculture.	3.67 0.91	3.82 0.92	3.71 0.93	4.02 0.83	4.00 0.71	1.397	.236
It would be easy to infuse sustainable agriculture into the curriculum.	3.48 1.25	3.81 0.87	3.78 0.88	3.79 0.97	4.00 0.71	.695	.596
Sustainable agriculture should be taught as a unit of instruction.	3.38 1.07	3.40 1.12	3.52 1.06	3.60 0.96	3.44 0.73	.384	.820
Teaching sustainable agriculture is an important part of my curriculum.	3.38 1.12	3.34 1.21	3.33 1.23	3.67 1.14	3.22 1.09	.919	.453
Teaching sustainable agriculture is the same as teaching conservation of natural resources.	3.52 1.12	3.43 1.06	3.42 1.21	3.38 1.25	3.11 1.36	.201	.933
Teaching about sustainable agriculture requires expert knowledge about sustainability.	3.19 1.17	3.22 1.03	3.36 1.08	3.59 1.04	2.89 1.53	1.506	.201
My students are very interested in learning about sustainable agriculture.	2.95 1.07	3.19 1.24	3.24 1.16	3.44 1.16	3.00 0.50	.930	.447

Scale: 1=Strongly Disagree. 2=Disagree. 3=Neutral. 4=Agree. 5=Strongly Agree.
F-statistics are small.

Independent two way-sample t-tests for differences in years of teaching experience in perceptions regarding teaching basic sustainable agriculture concepts among secondary school teachers of agriculture n=246.

Perception Statements	1 n=100 Mean S.D	2 n=94 Mean S.D	3 n=47 Mean S.D	4 n=5 Mean S.D	t-ratio	t-prob.
A variety of methods could be used to teach sustainable agriculture	4.31 0.76	4.16 0.78	4.28 0.71	4.20 0.45	.680	.565
Teaching the definition of sustainable agriculture is a critical step in learning about sustainability.	4.10 0.87	4.13 0.81	4.15 0.88	4.00 0.71	.072	.975
Teaching about sustainable agriculture practices would add balance to the curriculum.	3.89 0.82	3.87 0.75	3.87 0.74	4.00 1.00	.049	.986
Sustainable agriculture practices should be incorporated into all areas of study in agriculture.	3.88 0.92	3.70 0.90	3.89 0.84	4.20 0.84	1.090	.354
It would be easy to infuse sustainable agriculture into the curriculum.	3.75 0.91	3.78 0.95	3.79 0.93	3.60 1.14	.074	.974
Sustainable agriculture should be taught as a unit of instruction.	3.43 1.06	3.55 1.07	3.55 0.93	3.20 1.10	.411	.745
Teaching sustainable agriculture is an important part of my curriculum.	3.54 1.14	3.38 1.20	3.23 1.27	3.60 1.14	.790	.501
Teaching sustainable agriculture is the same as teaching conservation of natural resources.	3.44 1.12	3.38 1.22	3.36 1.22	3.80 1.10	.247	.864
Teaching about sustainable agriculture requires expert knowledge about sustainability.	3.30 1.09	3.40 1.06	3.38 1.17	3.00 1.00	.333	.802
My students are very interested in learning about sustainable agriculture.	3.30 1.25	3.17 1.11	3.28 1.08	3.40 1.14	.244	.866

Scale: 1=Strongly Disagree. 2=Disagree. 3=Neutral. 4=Agree. 5=Strongly Agree.
F-statistics are small.

t-tests for highest level of education in regarding teaching basic sustainable agriculture concepts among secondary school teachers of agriculture n=246.

Perception Statements	Bachelor's Degree n=144 Mean S.D	Master's Degree n=99 Mean S.D	t-ratio	t-prob.
A variety of methods could be used to teach sustainable agriculture	4.36 0.73	4.11 0.74	.943	.333
Teaching the definition of sustainable agriculture is a critical step in learning about sustainability.	4.19 0.78	4.04 0.91	.115	.735
Teaching about sustainable agriculture would add balance to the curriculum.	3.94 0.77	3.77 0.77	.303	.583
Sustainable agriculture practices should be incorporated into all areas of study in agriculture.	3.85 0.94	3.78 0.84	.161	.689
It would be easy to infuse sustainable agriculture into the curriculum.	3.82 0.91	3.71 0.95	1.323	.251
Sustainable agriculture should be taught as a unit of instruction.	3.53 1.11	3.44 0.96	2.535	.113
Teaching sustainable agriculture is an important part of my curriculum.	3.53 1.21	3.29 1.17	.140	.709
Teaching sustainable agriculture is the same as teaching conservation of natural resources.	3.47 1.23	3.33 1.08	3.076	.081
Teaching about sustainable agriculture requires expert knowledge about sustainability.	3.33 1.16	3.35 0.98	4.390	.037
My students are very interested in learning about sustainable agriculture.	3.31 1.20	3.19 1.08	1.787	.183

Independent two way-sample t-tests for In-service training in perceptions regarding teaching basic sustainable agriculture concepts among secondary school teachers of agriculture n=246.

Perception Statements	No In-service n=165 Mean S.D	In-service n=81 Mean S.D	t-ratio	t-prob.
A variety of methods could be used to teach sustainable agriculture	4.22 0.76	4.31 0.75	.018	.895
Teaching the definition of sustainable agriculture is a critical step in learning about sustainability.	4.11 0.85	4.16 0.83	.444	.506
Teaching about sustainable agriculture would add balance to the curriculum.	3.88 0.79	3.89 0.74	.530	.467
Sustainable agriculture practices should be incorporated into all areas of study in agriculture.	3.75 0.92	3.96 0.84	3.418	.066
It would be easy to infuse sustainable agriculture into the curriculum.	3.73 0.90	3.83 0.98	.221	.639
Sustainable agriculture should be taught as a unit of instruction.	3.48 1.07	3.53 0.98	.325	.569
Teaching sustainable agriculture is an important part of my curriculum.	3.31 1.23	3.65 1.06	4.822	.029*
Teaching sustainable agriculture is the same as teaching conservation of natural resources.	3.44 1.17	3.35 1.21	.211	.647
Teaching about sustainable agriculture requires expert knowledge about sustainability.	3.40 1.03	3.25 1.21	2.521	.114
My students are very interested in learning about sustainable agriculture.	3.17 1.24	3.41 0.97	2.899	.090

Scale: 1=Strongly Disagree, 2=Disagree, 3=Neutral, 4=Agree, 5=Strongly Agree.

t-tests for where teachers were raised in sustainable agriculture concepts among secondary school teachers of agriculture n=246.

Perception Statements	1 n=215 Mean S.D	2 n=19 Mean S.D	3 n=10 Mean S.D	t-ratio	t-prob.
A variety of methods could be used to teach sustainable agriculture	4.27 0.77	4.00 0.67	4.20 0.63	1.129	.325
Teaching the definition of sustainable agriculture is a critical step in learning about sustainability.	4.14 0.85	4.05 0.62	3.80 1.03	.833	.436
Teaching about sustainable agriculture practices would add balance to the curriculum.	3.89 0.78	3.89 0.57	3.80 1.03	.063	.939
Sustainable agriculture practices should be incorporated into all areas of study in agriculture.	3.84 0.91	3.58 0.96	3.90 0.74	.812	.445
It would be easy to infuse sustainable agriculture into the curriculum.	3.75 0.96	3.63 0.83	4.20 0.42	1.295	.276
Sustainable agriculture should be taught as a unit of instruction.	3.53 0.99	3.26 1.05	3.10 1.85	1.354	.260
Teaching sustainable agriculture is an important part of my curriculum.	3.50 1.83	2.79 1.13	3.10 1.10	3.613	.028*
Teaching sustainable agriculture is the same as teaching conservation of natural resources.	3.45 1.21	3.05 0.91	3.40 0.84	1.006	.367
Teaching about sustainable agriculture requires expert knowledge about sustainability.	3.38 1.11	3.16 1.07	3.10 0.74	.619	.539
My students are very interested in learning about sustainable agriculture.	3.30 1.19	3.90 0.94	2.80 0.79	1.860	.158

t-tests for gender differences in skills and knowledge in sustainable agriculture among secondary school teachers of agriculture n=246.

Skills & Knowledge Statements	Male n=199 Mean S.D	Female n=47 Mean S.D	t-ratio	t-prob.
Soil erosion control	4.07 0.96	3.96 1.04	.743	.458
Soil testing	3.91 0.95	3.81 1.06	.642	.521
Soil conservation	3.89 0.98	3.78 1.04	.666	.506
Management of soil fertility	3.81 0.93	3.55 1.08	1.576	.116
Water management	3.55 1.02	3.55 1.08	-.033	.974
Integrated pest management	3.51 1.10	3.40 1.15	.573	.567
Crop rotation	3.40 1.06	3.11 1.32	1.427	.159
Waste management	3.15 1.10	3.19 1.21	-.223	.823
Reduced use of chemicals	3.17 1.09	3.00 1.06	.929	.354
Risk management	3.09 1.11	2.81 1.12	1.579	.116
Mixed cropping	3.09 1.12	2.62 1.26	2.365	.021*
Mixed farming	3.06 1.04	2.68 1.29	1.882	.065
Reduced use of fertilizer	2.99 1.14	2.93 1.17	.289	.773
Green manure	2.78 1.09	2.15 1.21	3.502	.001**
Mono-cropping	2.57 1.18	2.40 1.19	.852	.395

Scale: 1=None: 2=Low: 3=Moderate: 4=High: 5=Very High.
*p<.05. **p<.01

Independent two way-sample t-tests for age differences for skills and knowledge in sustainable agriculture among secondary school teachers of agriculture n=246.

Skills & Knowledge Statements	1 n=21 Mean S.D	2 n=67 Mean S.D	3 n=86 Mean S.D	4 n=63 Mean S.D	5 n=9 Mean S.D	t-ratio	t-prob.
Soil erosion control	4.38 0.74	4.04 1.09	3. 98 0.91	4.10 0.93	3.78 1.48	.929	0.448
Soil testing	4.23 0.77	3.80 1.02	3. 86 0.88	3.95 1.01	3.56 1.42	1.160	0.329
Soil conservation	4.05 0.86	3.76 1.10	3.88 0.86	3.95 1.06	3.67 1.50	0.572	0.683
Management of soil fertility	4.05 0.67	3.70 1.03	3.64 0.93	3.94 0.93	3.22 1.30	2.125	0.078
Water management	3.86 0.91	3.51 1.04	3.42 1.03	3.71 0.96	3.22 1.48	1.491	0.205
Integrated pest management	3.62 0.97	3.48 1.17	3.50 1.08	3.51 1.09	3.00 1.41	0.514	0.726
Crop rotation	3.43 1.12	3.33 1.11	3.26 1.10	3.48 1.15	3.22 1.39	0.408	0.803
Waste management	3.43 1.03	3.11 1.12	3.01 1.12	3.35 1.09	3.00 1.50	1.214	0.305
Reduced use of chemicals	3.38 1.12	2.93 1.08	3.07 1.05	3.40 1.10	2.89 1.45	1.982	0.098
Risk management	3.19 0.98	2.87 1.06	2.98 1.14	3.30 1.12	2.67 1.12	1.747	0.140
Mixed cropping	2.95 1.12	3.00 1.27	2.92 1.17	3.14 1.05	2.89 1.17	0.372	0.828
Mixed farming	2.82 1.03	3.00 1.19	2.91 1.09	3.21 1.00	2.56 1.13	1.236	0.296
Reduced use of fertilizer	3.29 1.15	2.87 1.15	2.90 1.06	3.16 1.21	2.67 1.32	1.216	0.304
Green manure	2.43 1.16	2.60 1.07	2.53 1.09	2.94 1.19	2.89 1.36	1.573	0.182
Mono-cropping	2.76 1.30	2.48 1.26	2.51 1.12	2.68 1.16	1.67 0.71	1.716	0.147

Scale: 1=Strongly Disagree. 2=Disagree. 3=Neutral. 4=Agree. 5=Strongly Agree.
F-statistics are small.

Independent two way-sample t-tests in years of teaching experience for skills and knowledge in sustainable agriculture among secondary school teachers of agriculture n=246.

Skills & Knowledge Statements	1 n=100 Mean S.D	2 n=94 Mean S.D	3 n=47 Mean S.D	4 n=5 Mean S.D	t-ratio	t-prob.
Soil erosion control	4.10 1.00	3.97 0.93	4.09 1.04	4.40 0.89	.537	.657
Soil testing	3.98 0.96	3.78 0.91	3.91 1.02	4.00 1.73	.746	.525
Soil conservation	3.84 1.01	3.88 0.91	3.91 1.04	4.00 1.73	.094	.963
Management of soil fertility	3.79 0.92	3.73 0.94	3.70 1.04	3.80 1.64	.107	.956
Water management	3.60 1.05	3.45 0.99	3.55 1.04	4.40 0.89	1.544	.204
Integrated pest management	3.63 1.08	3.37 1.09	3.45 1.18	3.20 1.48	1.021	.384
Crop rotation	3.37 1.11	3.34 1.12	3.26 1.11	3.80 1.64	.389	.761
Waste management	3.31 1.14	2.99 1.11	3.09 1.08	4.00 0.71	2.360	.072
Reduced use of chemicals	3.10 1.11	3.09 1.07	3.28 1.16	3.40 0.89	.451	.717
Risk management	2.97 1.07	3.11 1.18	3.06 1.01	3.00 1.41	.220	.882
Mixed cropping	2.98 1.22	3.04 1.12	2.96 1.10	3.00 1.41	.073	.975
Mixed farming	2.95 1.15	3.04 1.04	2.94 1.13	3.20 0.84	.213	.888
Reduced use of fertilizer	3.04 1.17	2.93 1.12	3.02 1.09	2.40 1.67	.608	.610
Green manure	2.62 1.12	2.56 1.11	2.89 1.18	3.00 1.41	1.082	.358
Mono-cropping	2.76 1.30	2.48 1.26	2.51 1.12	2.68 1.16	.827	.480

Scale: 1=Strongly Disagree. 2=Disagree. 3=Neutral. 4=Agree. 5=Strongly Agree.
F-statistics are small.

Independent two way-sample t-tests for highest level of education in skills and knowledge among secondary school teachers of agriculture n=246.

Skills and Knowledge Statements	Bachelor's Degree n=144 Mean S.D	Master's Degree n=99 Mean S.D	t-ratio	t-prob.
Soil erosion control	4.15 0.87	3.92 1.11	2.319	.129
Soil testing	3.92 0.93	3.87 1.03	.534	.465
Soil conservation	3.97 0.93	3.75 1.05	3.196	.075
Management of soil fertility	3.82 0.91	3.66 1.05	3.074	.081
Water management	3.53 0.97	3.58 1.12	1.848	.175
Integrated pest management	3.45 1.10	3.58 1.12	.003	.955
Crop rotation	3.35 1.12	3.36 1.12	.017	.895
Waste management	3.19 1.07	3.13 1.21	2.316	.129
Reduced use of chemicals	3.12 1.09	3.20 1.11	.558	.456
Risk management	3.13 1.06	2.93 1.15	1.102	.295
Mixed cropping	2.96 1.16	3.08 1.15	.120	.730
Mixed farming	2.93 1.09	3.09 1.11	.012	.913
Reduced use of fertilizer	2.99 1.14	3.00 1.13	.015	.903
Green manure	2.69 1.14	2.63 1.14	.119	.730
Mono-cropping	2.60 1.23	2.43 1.09	2.907	.089

Scale: 1=Strongly Disagree. 2=Disagree. 3=Neutral. 4=Agree. 5=Strongly Agree.

Independent two way-sample t-tests for Inservice training education in skills and knowledge among secondary school teachers of agriculture n=246.

Skills and Knowledge Statements	No n=165 Mean S.D	Yes n=81 Mean S.D	t-ratio	t-prob.
Soil erosion control	4.04 0.98	4.09 0.98	.053	.818
Soil testing	3.81 0.98	4.05 0.93	1.274	.260
Soil conservation	3.84 1.01	3.94 0.97	.827	.364
Management of soil fertility	3.68 0.93	3.89 1.02	.047	.829
Water management	3.48 1.04	3.69 1.10	.526	.469
Integrated pest management	3.45 1.17	3.56 0.99	5.580	.019
Crop rotation	3.24 1.13	3.57 1.08	.365	.546*
Waste management	3.06 1.07	3.36 1.10	1.562	.213
Reduced use of chemicals	2.99 1.13	3.43 0.97	.244	.622
Risk management	2.85 1.19	3.23 1.02	10.332	.001
Mixed cropping	2.83 1.16	3.35 1.07	1.108	.294
Mixed farming	2.82 1.11	3.32 1.10	.977	.324
Reduced use of fertilizer	2.85 1.19	3.23 1.02	3.684	.056
Green manure	2.58 1.17	2.81 1.05	2.899	.090
Mono-cropping	2.48 1.25	2.65 1.03	5.104	.025

Scale: 1=Strongly Disagree. 2=Disagree. 3=Neutral. 4=Agree. 5=Strongly Agree.

Independent two way-sample t-tests on where teachers grew up regarding sustainable agriculture among secondary school teachers of agriculture n=246.

Skills & Knowledge Statements	1 n=215 Mean S.D	2 n=19 Mean S.D	3 n=10 Mean S.D	t-ratio	t-prob.
Soil erosion control	4.12 0.94	3.95 0.78	3.00 1.49	6.627	.002*
Soil testing	3.93 0.95	3.74 1.10	3.40 1.17	1.702	.185
Soil conservation	3.92 0.99	3.68 0.89	3.20 1.23	2.918	.056
Management of soil fertility	3.79 0.98	3.58 1.12	3.50 1.43	.772	.463
Water management	3.58 1.01	3.37 1.01	3.40 1.43	.496	.610
Integrated pest management	3.51 1.08	3.21 1.27	3.40 1.51	.667	.514
Crop rotation	3.39 1.12	3.11 1.15	2.90 1.21	1.363	.258
Waste management	3.17 1.10	3.16 1.26	3.10 1.37	.020	.980
Reduced use of chemicals	3.13 1.09	3.26 1.11	3.10 1.15	.140	.870
Risk management	3.07 1.10	2.89 1.05	2.50 1.18	1.467	.233
Mixed cropping	3.04 1.16	2.58 1.07	2.90 1.37	1.402	.248
Mixed farming	3.01 1.19	2.74 1.11	2.90 1.29	.564	.570
Reduced use of fertilizer	2.97 1.14	3.16 1.17	3.00 1.41	.240	.787
Green manure	2.71 1.13	2.21 0.92	2.70 1.42	1.689	.187
Mono-cropping	2.61 1.21	1.95 0.85	2.40 1.26	2.706	.069

Scale: 1=Strongly Disagree. 2=Disagree. 3=Neutral. 4=Agree. 5=Strongly Agree.
F-statistics are small.

Independent two way-sample t-tests for gender differences in selected in-service training about sustainable agriculture among secondary school teachers of agriculture n=246.

In-service Training Statements	Male n=199 Mean S.D	Female n=47 Mean S.D	t-ratio	t-prob.
Insect resistant crops	3.80 0.96	3.74 0.99	.347	.729
Herbicide resistant crops	3.78 0.96	3.70 0.95	.527	.599
Environmental protection	3.68 1.01	3.91 0.95	-1.431	.154
Farming profitability	3.75 1.01	3.57 0.10	1.100	.272
Rural culture & preservation	3.37 0.37	3.43 1.02	-.337	.737
Soil types and management	3.35 1.07	3.45 1.04	-.582	.561
Soil structure	3.29 1.13	3.30 1.16	-.035	.972
Crop productivity	3.21 0.98	3.38 1.05	-1.068	.286
Climatic factors	3.21 0.94	3.28 0.95	-.463	.644
Tillage techniques	3.19 0.98	3.11 1.15	.484	.629

Scale: 1=None; 2=Low; 3=Moderate; 4=High; 5=Very High.
*p<.05, **p<.01

Independent two way-sample t-tests for age differences in selected in-service training about sustainable agriculture among secondary school teachers of agriculture n=246.

In-service Training Statements	1 n=21 Mean S.D	2 n=67 Mean S.D	3 n=86 Mean S.D	4 n=63 Mean S.D	5 n=9 Mean S.D	t-ratio	t-prob.
Insect resistant crops	4.00 1.00	3.66 0.98	3.67 0.94	3.97 0.93	4.11 1.05	1.690	.153
Herbicide resistant crops	4.00 1.00	3.63 0.93	3.69 0.96	3.92 0.94	4.00 1.00	.243	.243
Environmental protection	4.14 0.85	3.64 1.03	3.65 1.05	3.73 0.95	4.11 0.78	1.499	.203
Farming profitability	4.00 0.95	3.61 0.95	3.65 0.94	3.76 1.16	4.33 0.71	1.640	.165
Rural culture & preservation	3.33 1.11	3.37 0.92	3.36 0.99	3.41 1.01	3.56 1.01	.109	.979
Soil types and management	3.90 1.14	3.22 0.98	3.22 1.10	3.44 1.12	4.00 1.12	3.052	.018*
Soil structure	3.38 1.41	3.21 1.09	3.16 1.04	3.41 1.21	4.22 0.83	2.101	.081
Crop productivity	3.86 0.96	3.21 0.99	3.02 0.98	3.27 0.94	4.00 0.71	4.667	.001**
Climatic factors	3.71 0.90	3.12 0.91	3.12 0.91	3.21 0.99	3.91 0.78	3.160	.015*
Tillage techniques	3.24 1.10	3.10 0.97	3.02 0.93	3.33 1.09	3.78 1.30	1.791	.131

Scale: 1=None: 2=Low: 3=Moderate: 4=High: 5=Very High.
*p<.05. **p<.01

Independent two way-sample t-tests in years of teaching experience for In-service training in sustainable agriculture among secondary school teachers of agriculture n=246.

In-service Training Statements	1 n=100 Mean S.D	2 n=94 Mean S.D	3 n=47 Mean S.D	4 n=5 Mean S.D	t-ratio	t-prob.
Insect resistant crops	3.82 1.04	3.68 0.94	3.91 0.80	4.00 1.22	.776	.508
Herbicide resistant crops	3.79 1.02	3.68 0.96	3.87 0.77	4.00 1.22	.560	.642
Environmental protection	3.73 1.01	3.68 1.03	3.85 0.86	3.40 1.52	.484	.694
Farming profitability	3.70 1.02	3.62 0.91	3.98 1.09	3.60 1.52	1.410	.240
Rural culture & preservation	3.33 1.01	3.34 1.01	3.57 0.85	3.40 1.14	.750	.523
Soil types and management	3.43 1.06	3.21 0.98	3.49 1.18	3.80 1.30	1.273	.284
Soil structure	3.31 1.19	3.17 1.04	3.47 1.14	3.60 1.52	.875	.455
Crop productivity	3.41 1.05	3.00 0.94	3.40 0.88	3.00 1.22	3.434	.018*
Climatic factors	3.27 0.87	3.09 0.91	3.36 1.05	3.40 0.89	1.161	.325
Tillage techniques	3.18 0.98	3.02 0.96	3.40 1.11	3.60 1.52	1.840	.141

Scale: 1=Strongly Disagree. 2=Disagree. 3=Neutral. 4=Agree. 5=Strongly Agree.
F-statistics are small.

Independent two way-sample t-tests for highest level of education for In-service training in sustainable agriculture among secondary school teachers of agriculture n=246.

In-service Training Statements	Bachelor's Degree n=144 Mean S.D	Master's Degree n=99 Mean S.D	t-ratio	t-prob.
Insect resistant crops	3.82 0.96	3.73 0.98	.049	.824
Herbicide resistant crops	3.81 0.95	3.71 0.97	.306	.580
Environmental protection	3.72 1.11	3.71 1.00	.004	.947
Farming profitability	3.77 0.96	3.63 1.07	1.051	.306
Rural culture & preservation	3.41 0.99	3.34 0.97	.174	.677
Soil types and management	3.41 1.07	3.29 1.04	.704	.402
Soil structure	3.38 1.11	3.18 1.15	.014	.907
Crop productivity	3.27 0.98	3.19 1.01	.002	.961
Climatic factors	3.20 0.94	3.22 0.94	.055	.814
Tillage techniques	3.22 1.01	3.08 1.01	1.719	.191

Scale: 1=Strongly Disagree. 2=Disagree. 3=Neutral. 4=Agree. 5=Strongly Agree.

Independent two way-sample t-tests for Inservice training education among secondary school teachers of agriculture n=246.

In-service Training Statements	No n=165 Mean S.D	Yes n=81 Mean S.D	t-ratio	t-prob.
Insect resistant crops	3.81 0.92	3.74 1.05	2.299	.131
Herbicide resistant crops	3.78 0.91	3.74 1.05	3.415	.066
Environmental protection	3.77 0.99	3.64 1.02	.283	.595
Farming profitability	3.68 0.96	3.79 1.09	.643	.423
Rural culture & preservation	3.33 0.96	3.48 1.01	.475	.492
Soil types and management	3.37 1.04	3.36 1.11	.334	.564
Soil structure	3.28 1.14	3.31 1.13	.001	.981
Crop productivity	3.22 1.01	3.31 0.97	.001	.974
Climatic factors	3.18 0.91	3.31 0.99	1.052	.306
Tillage techniques	3.07 0.99	3.38 1.03	1.874	.172

Scale: 1=Strongly Disagree. 2=Disagree. 3=Neutral. 4=Agree. 5=Strongly Agree.

Independent two way-sample t-tests on where teachers grew up regarding sustainable agriculture among secondary school teachers of agriculture n=246.

In-service Training Statements	1 n=215 Mean S.D	2 n=19 Mean S.D	3 n=10 Mean S.D	t-ratio	t-prob.
Insect resistant crops	3.78 0.98	3.63 0.91	4.30 0.67	1.676	.189
Herbicide resistant crops	3.76 0.97	3.63 0.91	4.20 0.63	1.219	.297
Environmental protection	3.73 1.01	3.68 0.95	3.70 1.06	.027	.974
Farming profitability	3.76 1.01	3.52 0.90	3.10 0.88	2.428	.090
Rural culture & preservation	3.36 1.11	3.63 0.83	3.40 0.84	.631	.533
Soil types and management	3.38 1.06	3.21 1.08	3.40 1.17	.228	.796
Soil structure	3.33 1.15	2.79 0.79	3.50 1.18	2.174	.116
Crop productivity	3.27 1.00	3.11 0.88	2.90 1.10	.879	.417
Climatic factors	3.22 0.94	3.26 0.81	3.30 1.25	.052	.949
Tillage techniques	3.19 1.02	3.11 0.99	2.90 1.10	.434	.649

Scale: 1=Strongly Disagree. 2=Disagree. 3=Neutral. 4=Agree. 5=Strongly Agree.

ACKNOWLEDGEMENTS

From the start of this research project, I made a personal commitment to walk with God, and I never stopped interacting with him. I know that he heard my cry, and I praise his name for taking my burden away. That has made me to become more prayerful, hardworking, humble to myself, and respectful to my professors. Living away from home is painful, but finding God fills the void. I am grateful that this research project gave me the opportunity to seek and find God.

I am grateful to my parents: Late Sir and Lady Joseph & Theresa Okeafor, who equipped me with the courage and strategies to overcome personal setbacks. They taught me to keep on trying regardless the obstacles. This helped me to learn to motivate myself, and to develop endurance that I used to survive my challenges. I was born poor to a family where finding two square meals a day was a struggle, but my parents taught me strength, devotion, perseverance and humor. I wish they were alive today to see how dearly I took their advice.

I lack the strong words to say "thank you" to my major professor, Dr. Robert A. Martin for his untiring efforts in making sure that this research project was completed in a timely manner. Dr. Martin has the interest of his students at heart, and he reminds them early to begin to work on their projects from day one. Though I lack the best way to express my gratitude to him, I appreciate his time and every hour I spent with him. Unlike many other professors, Dr. Martin is a good listener, and his open door policy gave me the opportunity to meet with him at any time to discuss my project. I am extremely honored to have him as my major advisor.

I am indebted to members of my committee, Dr. David L. Williams, Dr. Lynn B. Jones, Dr. Paul Lasley, and Dr. Larry Bradshaw, for patiently working with me since this research

project began. They were present during my POS meeting. They equally came during my preliminary exams and final defense. They had time to read my papers, and I thank them for considering my work good enough to allow me to join the list of selected educated people at Iowa State University, in the United States, and around the world. For the rest of my life, my committee members have collectively made me to be proud of myself, and for this reason, I cannot thank them enough.

When the Statistical Analysis was weighing heavily on me, the type of support I received from Dr. Gaylan Scofield, and Dr. Mack C. Shelley cannot be over-emphasized. The best way to express my gratitude to them is "there is a miracle for every mountain." Also, I believe that God uses some individuals on earth to tell us that he has not stopped watching over us. It is only when we have difficulties that we know those who sincerely care about us. What Dr. Scofield, and Dr. Shelley did for me will always be remembered.

I wish to thank Linda Drennan, and Cheryl Abrams, departmental secretaries.for maintaining effective communication with me during my stay in this school. There were moments I would be so busy to remember what was going on in the department, but these secretaries have different ways to keep all students posted. They use mail-boxes, send e-mail messages, or call on the telephone about issues of importance that contributed to the completion of this program. Cheryl particularly helped me with envelopes and other support for my instrument. When you look into her eyes, you will believe that she cares about the students. May God bless her in a special way.

Finally, I owe my love to my wife and children, Esther, Onyema, and Onyekwere, for their patience, endurance, understanding and dreams of hope. At this time of heightened concern for the completion of my program, Esther proved that she is my wife and sincerely

behind my success. She was a single parent and still struggling for her own career. My children understood, and I do not know how to tell them how much I love them, but their willingness to endure the separation provided the road map that I used for my success. They suffered the pain of discipline and regret, but God's blessings over them was an umbrella that challenged them to remain tough. For the rest of our lives, we will serve God.